William Aaron Nierenberg

Feb. 13,1919-

William Aaron Nierenberg was born on February 13, 1919 at 228 E. 13th St. in New York City on what was then the Lower East Side -- it is now the "East Village". While it is true that his father and his father's family had lived on the Lower East Side (Houston Street) when they had emigrated to America (his father in 1906), it was an accident that his birthplace was there. His parents, Joseph and Minnie (Drucker) had moved to Manhattan from the Bronx to be near the Sloan Lying in Hospital for his birth. His parents had lost their first infant child to tuberculosis of the brain from tainted milk and his mother was naturally very nervous about the new child's safety. He only lived in Manhattan for the next four months and the rest of his years in New York City, both before and after his marriage, were spent in the Bronx except for time in Paris as a physics student.

There is essentially no specific knowledge of his antecedents. His paternal grandfather's given name was Hirsch and his paternal grandmother's name was Bertha. He had no knowledge whatsoever of his maternal forebears. His parent's gravestone showed his grandfather (therefore his father and he himself) to be a Levi, of the tribe blessed by the Lord. His mother's gravestone describes her as a "daughter of Abraham" since her antecedents were unknown to the burial society.

(Many years later. most surprisingly, her birth certificate showed up! This is the one that Aba's daughter gave me a copy of. I suspect that it was in my uncle's things when he died and that he had a copy be cause he and Hymie needed it to bring my mother to the US. There are also agencies that can locate such documents and, even more remarkable, they even still exist over one hundred years later after a history of pogroms, two world wars and Adolph Hitler. In addition, these certificates contain far more information than my own from New York City, for example. It seemed to be the practice to insert whatever collateral family information available at the moment. The first item I noticed was that her birthday was 14 October 1892. This was quite interesting and even amusing. My mother always said that she had no recollection of her exact birthday. On my birth certificate she had inserted age 24. However, her birth certificate showed that she was twenty-seven when I was born. I do not believe that she could have been so unknowing as to be off by three years. My surmise is that she well knew her age but was going as three years younger, a woman's prerogative, and I will never know whether my father was ever aware of this white lie. In any event he was still three years older than she. I have to say that my father claimed to be born in June 1989, but he did not know the exact day of the month.

What was equally interesting is the question of names. My mother's name was inscribed as Menie (instead of Minnie) and she had a middle name of Divorah that I learned of for the first time. While she grew up in Stanislowow now called Mariampol, in Austro-Hungary, she was born in Czernelica, her parents' home at the time. Her father' name is given as Morizka Rebarber and her mother's name as Blima Druker. There is a curved diacritical mark over the u that I do not understand. It may be a quick way of writing an umlaut. This seems to fit her statement that her mother regained her maiden name after her father's death (or disappearance?).

What is even more fascinating is that my grandmother's (Blima), parents are also listed. This would not be important for this narrative except, again, for the family names. Her father's name is Chain Wolf but her mother's name is given as Lea Druker, also with the curved superscript. It is as if there seems to be a matriarchal tendency as an alternative explanation to my mother's as to the conflict between Rebarber and Drucker. It is also possible that none of these pairs were legally married. Finally Blima's parents came from Bohorogzan.)

Although Nierenberg spent the majority of his life in California and was solidly identified as a Californian, he never lost his love of and interest in New York City, particularly the Bronx and Manhattan. The principal reason undoubtedly were the powerful cultural and educational institutions expressed in the excellent schools, public library system and museums of his time that he benefited from.

These included the Bronx Botanical Garden and the Zoo which were within walking distance of his various homes in the Bronx until he married and moved to the Wakefield section of the Bronx which abutted Mount Vernon and was just north of the more famous Woodlawn section.

The first ten years of his life were spent in the neighborhood which is located in what is now pejoratively called the South Bronx and was then called the East Bronx because it lay east of the Grand Concourse which formed the "railroad tracks" that separated the upper and lower classes. (The address of this first Bronx home was 929 E. 165th Street, around the corner from Kelley Street where general Colin Powell grew up.) But it never then was so far gone as to resemble the current "Fort Apache" of movie fame that was centered on his old neighborhood. It was an obviously lower class part of New York City but the population, mostly immigrants and their first generation offspring, were a hard working, industrious lot who valued education highly. They remained that way throughout the Great Depression that was to follow shortly. The Simpson Street Police Station was in his neighborhood but the police then were considered friends and the favorite cop on the beat was nicknamed "Whistle" -- for everybody had a nickname and Whistle was one of the standard epithets for a policeman on the beat. One of the older members of his "gang" would proceed down the street leapfrogging the fire pumps. Naturally, he was nicknamed "Pump". Nierenberg was the "Brain".

Except for the northern parts of the borough like Wakefield and its southern neighbor, Williamsbridge, that abutted the more famous Woodlawn, there was little evidence left but the neighborhood names of the many villages that had coalesced to form the Bronx early in the century. His elementary school from the second grade on was PS 23 that was also known as the Woodstock School after the original village as was the local public library where he spent many hours. The best known village name in the Bronx was (and perhaps still is) Woodlawn, because of the cemetery located there.

His deep interest in science was manifested at a very early age. In later years he remembered with some bitterness a science contest held in the American Museum of Natural History. He must have been in the fourth grade and the competition had to have been a forerunner of the Westinghouse Science Fair. His love then was astronomy and the mythology associated with the constellations. He submitted a composition in brochure form on the story of the constellations -- Orion with his Dog, the Bull, the Pleiades and so on. It made so great an impression on the museum people that they never returned his work -- hence his annoyance. To the day he died he marked the beginning of a new year with the appearance of Orion's belt in the sky.

As he went through school he was involved in several competitions. In Townsend Harris High School he was on the winning team in the city-wide mathematics competition, the Pi Mu Epsilon. One of his two team mates was Victor Wouk, the brother of Herman Wouk, both of whom had attended the same school. In his senior year, he and some classmates submitted two entries to the science competition at the American Museum of Natural History that won first and second prizes respectively. There was a stipend for books and he purchased a copy of Coffin's Vector Analysis that was eventually loaned (permanently!) to Bernard Feld, a classmate at The City College and Columbia University and a colleague in physics.

Of all the schools he attended the one that he remembered most fondly and the one that made the most lasting impression was Townsend Harris High School. It was only for the very best students from within fifty miles of Columbus Circle and who had to take a competitive examination for admittance to the relatively small high school. He discovered that that feeling was shared by most of his classmates. It was the first major step in extracting him from the extreme provinciality of the East Bronx. He entered THHS in February 1933.

A fortuitous situation existed at THHS in that the only science offered was physics. Most New York City high schools at the time offered a choice of chemistry, physics or biology but THHS, being so small and living precariously as a guest in the 23rd Street building of the City College of New York could only offer one science. As a measure of its classical nature, physics was the choice. If it had been another science, Bill would have undoubtedly gone elsewhere, probably to Peter Stuyvesant High School, the other

premium choice. The Bronx High of Science was just beginning at that time but Nierenberg always believed that it was a poor substitute for THHS. Mayor LaGuardia closed down THHS in about 1943 to generate funds for the Bronx High School of Science largely because of his friendship with Morris Meissner, the founder of the Bronx High School of Science but also because of his inability to adjust personally to the director and assistant director of THHS who belonged more to a WASPish Teddy Roosevelt era. The goal was to divert the superior student to the new school for they persisted in making tracks to THHS.

The most remarkable feature of THHS, second only to the quality of its students, was the extraordinary collection of teachers. Among them were Mario Pei, who later became a professor of languages at Columbia University, René Carrié, who also went to Columbia as a professor of philosophy although he had been Nierenberg's mathematics teacher, and Charles Mendelsohn, who had been prominent as a cryptographer in World War I and who is mentioned in Barbara Tuchman's book, the Zimmerman Message, and was a central character of a novel about his and his colleagues' exploits.

A situation that weighed very heavily in Nierenberg's thinking the rest of his life was the Communist influence in both THHS and CCNY, his later Alma Mater. During his last year in THHS and his first years at CCNY there was the Rapp-Coudert state leglislature investigation of communism of the City College. It was a witch hunt but there was no question that at least one major cell existed at the time and it involved two of his favorite teachers, Ivan Hurlinger of physics and David Goldway of English, among others. Hurlinger was forced to leave the school and it was particularly painful because he had been Nierenberg's mentor throughout. Nierenberg had been essentially self supporting since the age of fourteen and had to work in a fur shop as a "floor boy" in summers and as a waiter in an ice cream parlor throughout the year to make his way. Hurlinger recognized his ability and provided additional employment by having him grade the physics laboratory papers. He also stepped in when Nierenberg entered CCNY as a freshman and registered for a physics section whose teacher he did not approve of. As Hurlinger explained it, the new section had a beginner whom he did not know but had to be better than Dr. Taylor! It turned out to be Morton Hamermesh, a recent PhD of Gregory Breit's at NYU, who not only was a superb instructor but was destined to make a prominent mark for himself in the world of physics.

There was no question in Nierenberg's mind but that he would be a math or physics major. This was not a simple decision in those early years because of the Great Depression that colored all career thinking. There were practically no openings for professional physicists as such and many students chose an education major in the hope of landing a New York City high school teaching position which could pay the enormous salary of $3000 a year with summer vacations and job security. The penalty, as always, was the large number of required education courses and hence the minimal number of physics or math courses that could be taken in the time available. Nierenberg once made a count of the upper division physics majors at CCNY at the same time. It was twenty-one to be compared with about two at Columbia at the time!

It was quite a collection among whom, in addition to Nierenberg, were Bernard T. Feld, Herbert Goldstein and William Havens, Jr.. This very large number of physics and math majors turned out by the school in the thirties made a recognizable contribution to the war effort in the Manhattan Project, the Proximity Fuse Project, the radar projects and a host of other more conventional wartime research and development efforts.

From the pedagogic viewpoint, CCNY then was a very good place to be for a physics major. The institution (and students) were blessed with such great teachers as Henry Semat, Mark Zemansky, Simon Sonkin and Walter Zinn. There were others who went on to make names for themselves like Clarence Zener, Sidney Millman and Morton Hamermesh. The students' experiences were indirectly enriched by the proximity of Columbia University where great research was being carried out by Enrico Fermi, I.I. Rabi and John R. Dunning as well as at NYU where Gregory Breit presided and was well complemented

later by Otto Halpern. Very little research was carried out at CCNY but the active faculty were heavily involved with programs at Columbia and NYU.

One typical and exciting event was a demonstration of induced radioactivity for a large lecture class of undergraduates performed by Hyman Goldsmith who was then working with Fermi. It was induced by neutron bombardment and the first such undergraduate demonstration ever.

In mathematics Nierenberg was exposed to Emil Post as a freshman in calculus and, also as a senior, to the theory of the function of a real variable. Post was a dedicated and inspired teacher and, while Nierenberg was given to understand that professor Post was also one of the great mathematicians of his time, it was only years later that he more fully understood his eminence, even rivaling that of Goedel's.

He captured pretty much all the college honors and medals available to him but the one he cherished the most was the Paul Kenyon Award. This is a medal, struck by Tiffany, that is awarded only occasionally when the mathematics department recognizes a student of exceptional ability. The memorable part was that it had not been awarded for four years before Nierenberg received it and then it had gone to Robert Hofstadter.

In his junior year, Nierenberg was awarded the Aaron Naumberg fellowship for an academic year abroad. The University of Paris was his choice for two reasons. The first was a clear indication by the president of the College, Frederick B. Robinson, that the alternative, Cambridge, was not a suitable place for a Jewish student, given its church orientation, and that the prize would go to someone else if he insisted on Cambridge. The second was Zemansky's suggestion that it would be an especially propitious time in Paris because both Charles Fabry and Léon Brioullin were teaching the physics courses that Nierenberg would be likely to attend. Unfortunately, when he arrived in Paris, Nierenberg discovered that both professors had given up their courses.

His experiences in Paris formed a second step after Townsend Harris in liberating him from the narrow provincialism of the East Bronx. (He had many friends, however, who believed that Nierenberg never lost his affinity for New York City.) There were some wonderful teachers there too. René Garnier, who taught the *Cinématique* part of the *Cour de Mécanique Rationelle* as well as the function of the real variable as part of the *Certificat de Calcul Différentiel et Intégral Avancé* was a superb lecturer. He also gave a special preparatory course for students who had not had the benefit of *Math Spé*, the course *Mathématiques Spéciales* that final year, good students took in the lycée, that Nierenberg also found it advisable to take. The calculus course was wonderful and excellent preparation for the physics major, especially in quantum mechanics. It was ironic for, because of the heavy hand of de Broglie, quantum mechanics was not being taught in France both before and immediately after WWII.

By contrast, the other math teacher, Arnaud Denjoy, was a disaster, possibly the worst teacher that he ever encountered. It was hard to reconcile with the accepted fact that Denjoy was the outstanding mathematician of the time in Paris, having been the inventor of the most powerful integral to date. But it all was compensated for by Andrew Léon Lichnérowicz who, as *remplaçant*, gave the *Travaux Pratiques* for the calculus and the mechanics courses. These problem sessions were excellent and it was no surprise to Nierenberg to learn, years later, of Lichnérowicz's prominence in French mathematics.

Nierenberg's French was more than adequate for the lectures that mostly took place at the *Institut Henri Pointcaré* in either the *amphitéatres Darboux* or *Hermite*. The *Physique Générale* was given in the lecture hall of the Sorbonne itself. After midterm, he enjoyed a certain notoriety among his fellow students because of the appearance of a translated version of the Granville, Smith and Longley calculus text at the *Librairies* on the Boulevard Saint Michel. This was the text that was very popular then in the United States and was employed at CCNY. It became an instant hit with the French students because the basic French texts were useless. As a result, Nierenberg became very popular in working over the homework assignments on the Friday nights before the problem sessions. The existing *Cour d,Analyse* of *Goursat-Hedrick or de La Vallée Poussin* were typical and were of no value as working texts. In

mechanics the best that was available was that of Paul Appel. There was a reasonable textbook in statistics by Émil Borel. By contrast, Lichnérowicz would assign problems from the English Tripos exams which also gave Nierenberg a preferred position among his fellow students.

Nierenberg tried to sit in on the lecture course on statistical mechanics led by Francis Perrin but it was too much, particularly a session attended by great names like Louis de Broglie, Élie Cartan and Maurice Fréchet and was given over to philosophic debates.

The atmosphere at the Sorbonne was so stimulating that he developed vague plans to stay on to obtain a doctorate in physics under the title *Doctorat d'Université*, a somewhat watered down version of the American PhD. This was technically possible and he felt that a close and wealthy French friend could arrange a financial vehicle for him. However, it was 1938 and the war tremors in Europe were too much for him and he wisely returned home to finish his bachelor's at CCNY.

Partly as a result of this experience abroad but more because of his avid reading of all available algebraic texts, like Chrystal's algebra that he could find in the school library, he was prepared for the invitation extended to him by professor Henry Malin to join the three man team to represent CCNY in the William Lowell Putnam intercollegiate math contest. At the time he did not realize the competition was only in its second year. One teammate was Harry Soodak. He finished with a first prize along with another first prize winner from a different school, Richard Feynman. The CCNY team received honorable mention Entry then was rather casual but today the teams prepare with as much application as the football team.

One event that had some bearing on his eventual involvement in geophysics occurred during his senior year. It was an outcome of his one required semester of geology. His professor was George Adams. He was exposed to the problem of the "Carolina Bayous". These are surface land features in North Carolina that have the appearance of having been caused by the simultaneous slanting impact of several meteorites. However, this explanation was in dispute and another argument was put forward -- a complex argument based on a break through of the surface to a low lying aquifer. It was based on an arm waving explanation involving changes in direction of the flow vectors in the aquifer. Nierenberg pointed out that the argument could be tested by modeling the D'Arcy flow in the aquifer. To do this he simulated the flow pattern that was controlled by Poisson's equation with a lead sheet progressively cut out to resemble the changing shape of the hole in the aquifer as the flow evolved. The lead sheet carried a current impressed by a voltage source and the equipotentials were laboriously plotted out using a type K potentiometer. The results clearly disproved the aquifer hypothesis. Years later, Nierenberg learned that King Hubbert had reviewed the subject and had conclusively established the meteoritic origin of the phenomenon.

Nierenberg was too unsophisticated then to appreciate the importance of publication. Forty-five years later, when he accidently learned of Hubbert's result, he got in touch with Adams to ask why he had not encouraged the publication of the modeling results. Adams explained that he tried to locate Nierenberg after commencement but failed.

Withal, Nierenberg graduated Summa cum Laude with Honors in Math and Physics and entered Columbia University as a graduate student, concurrently teaching physics at CCNY with a specially arranged title as Tutor that Sonkin and the others had set up for special graduates. One of the reasons for the practice was the difficulty they had in placing their top students with assistantships at the better universities because they were mostly Jewish. (This situation changed radically after the war.) While this was generally true of the Ivy League schools like Harvard, Yale and Princeton it was not so of Stanford, for example, which offered Nierenberg a position that, however, was not financially feasible. He always regretted not making more of an effort in this regard because he would have worked with Felix Bloch, someone already famous and someone whom he would get to know better and admire in later years.

At Columbia, Nierenberg enjoyed the presence of some of the greatest physicists of the time. As he would often later say, he should have won several Nobel Prizes from the experience of learning from

this assemblage. It included Fermi, Rabi, Dunning, Lamb, Nordsieck, Joe Mayer, Marie Mayer and Maurice Biot. Hans Bethe spent a sabbatical year there and taught the famous nuclear physics course that had just appeared in the Reviews of Modern Physics and Edward Teller was a frequent visitor as well.

Fermi affected Nierenberg as he did everyone. He was a most extraordinary lecturer on any branch of physics he chose. His most important series was his seminar on advanced nuclear physics that concentrated heavily on slow neutron phenomena. It was in these lectures that he demonstrated the utility of the scattering length and the virtue of his version of the Born approximation in scattering calculations that became known as the Golden Rule after the war among the graduate students. His most appealing feature was the revealing simplifications of what were normally displayed as extremely complex computations in the literature. A good example occurred in his course in geophysics that he had earlier given in Rome and then repeated at Columbia. This was a tremendous simplification of Jeffrey's treatment of the cooling of a spherical earth including the heating due to radioactivity. The various Fermi tricks were saved by Nierenberg and used consistently throughout his productive career. This included various aspects of Fermi's techniques employed in his famous paper on the quantization of the electromagnetic field in the Reviews of Modern Physics. (A whole generation of students used the Born approximation as derived by Fermi and called the "Golden Rule"!

It was the combination of Fermi's geophysics course and Biot's course in advanced mechanics that started Nierenberg on a degree in geophysics, specifically anisotropic earthquake propagation. Biot had published extensively on his own theory of elasticity in a medium already under finite strain. The application to seismology was to have been Nierenberg's thesis and was well under way when Biot left to work with Von Karman at Cal Tech on wing flutter for the sense of impending war was everywhere. The effort was not all wasted for what Nierenberg learned stood him in great stead in his later antisubmarine warfare research with the Navy and as director of the Hudson Laboratories of Columbia University as well as during his tenure as director of the Scripps Institution of Oceanography. Russel Raitt at the Scripps Institution of Oceanography, in particular, demonstrated the existence of anisotropic propagation of seismic waves although the cause is still obscure but probably not due to finite stress.

It was a difficult time for a student for thesis completion because faculty kept coming and going due to the ongoing preparations for war. The next serious involvement was under the tutelage of Willis Lamb, something he considered a real privilege. The subject was order-disorder theory, the two dimensional Ising model in particular. Much work had been published on the subject but no exact solution had been obtained except for the critical temperature that had been recently obtained by Hendryk A. Kramers and Gregory Wannier. Nierenberg made little progress and when he was exposed to Lars Onsager's solution at a meeting of the New York section of the American Physical Society, he realized that he never would have made it. However, it again it was not all wasted. For, maintaining a permanent interest in that class of problem, in 1952 his attention was drawn to a paper of Ronald W. Gurney's that fitted data on the specific heat of graphite at low temperature to a Debye approximation. Nierenberg found an exact solution to this two dimensional problem that has been and still is regularly cited. He would mention this with a slight touch of cynicism for he considered this a minor achievement but it has been more continuously cited than what he considers his major work -- that in radioactive atomic beams.

This was now the fall of 1941 and there had been much upheaval in the faculty both at Columbia where members scattered to various defense installations and at CCNY where many also took leave to schools like NYU to teach suddenly needed subjects like meteorology. Nierenberg sensed that United States involvement in the war was imminent and, anticipating that he would not escape military action, opted for special enlistment as a naval pilot via the auspices of professor Harold Webb, the graduate advisor, who was an unofficial recruiter for the US Navy as well. In the middle of the process he was approached by both Fermi and Dunning who were both involved in their preliminary activities that led to the Manhattan Project. Because Fermi's displacement of his laboratory to Chicago represented a time conflict with his impending marriage (November 21, 1941) Nierenberg opted for remaining in New York City with Dunning. The argument was that they, the small group of physicists and chemists that included Harold Urey, Eugene Booth, Clark Williams, Francis Slack, William Havens, James Rainwater, Bill

Libby, Henry Bourse, among others, would work on their project for six months and then turn it over to the engineers for completion. At that point, according to Williams, they could all join the Navy for that was a physicist's tradition that was left over from WWI when magnetic mines and ship degaussing were major technical concerns.

This represented a good measure of the failure of the leading scientists to appreciate the growing importance of technology in the war effort in particular and society in general. The project grew exponentially from this small beginning. In time, other distinguished scientists became attached to the project such as Maria Mayer, Elliott Montroll, Richard Present and many others too numerous to list here. A proper history of this eminently successful project on the gaseous diffusion plant for the separation of ^{235}U has never been written because of the secrecy that still shrouds its development after more than fifty years.

Young scientists like Nierenberg were pushed many years ahead in responsibility by the rapid wartime developments. In a very short time he was the head of a large technical section of about thirty investigators with a corresponding budget. He also was the head of a short-lived group at the top-secret level for a special development as well as being a member of the theoretical group headed by Karl Cohen, a former student of Harold Urey's. His responsibilities developed from the invention of the Hi-Cut technique for measuring the properties of the diffusion membranes as they were developed. It was a relatively simple apparatus that replaced five complex and expensive pilot stages that were designed to achieve the same end. He also was responsible for another apparatus that determined the basic separation factor of a membrane independently of the normal perturbing factors such as cut and mixing inefficiencies.

These were patented and transferred to Oak Ridge where they were continually employed during the start up of the plant. In the theoretical sphere he developed some simple plots for estimating the hold up time of each section of the plant that were regularly employed in the startup process. As he often was wont to say in later life, he worked for four years as a chemical engineer but did not realize it! This led to an interesting happening. When he entered the project in November, 1941, he realized that the membrane testing, done with an inert mixture of helium and carbon dioxide, was faulty because it did not take into account the effect of the "cut", that is the fraction of the gas that flows through the membrane. He developed a formula that gave a standardised and meaningful performance of the membrane at zero cut. This so impressed Dunning that he had carbon copies made (There were no Xerox machines then!) and sent to all hands. As the program grew, this formula became known as the Nierenberg Cut Correction. Six months later when Nierenberg discovered the Chemical Engineering Handbook he also discovered that Lord Rayleigh had already derived the formula for application to his Argon experiments, although in somewhat different mathematical form. He tried to follow up on the earlier note but it was too late because of the rapid expansion of the project and the corresponding expansion of the number of copies.

At the point when a decision was made to go ahead with the diffusion project, the management of the laboratory and Oak Ridge, where the plant was to be built, was turned over to the Carbide and Carbon corporation, a unit of the Union Carbide Corporation. The engineering design was accomplished by the Kellex corporation, a spin-off of the M. W. Kellogg Corporation who were chosen because of their great experience in building oil refineries which operate on the same general fractionation principles as the K-25 plant as it had been designated. The man nominally in charge was a colorful field engineer, "Dobey" Keith, but the real chief engineer was Manson Benedict who never received adequate credit for his tremendous and successful accomplishments. Nierenberg worked closely with his team, particularly Arthur Squires. Between the two of them, employing the Hi-Cut experimental techniques, they developed the basic empirical equations for the membranes that were the basis for estimating the performance of the ultimate separation plant.

Among the upper echelon executives of Carbide and Carbon was Augustus B. Kinzel who was to become an important member of the post war technical elite and was heavily involved in the formation of

many of the not-for-profits that marked that era. He was a principal in the founding of the National Academy of Engineering and was its first, acting president. The two renewed their acquaintance when Nierenberg came to La Jolla in 1965 to where Kinsel had retired only to be persuaded to accept the presidency of the newly formed Salk Institute. It was a remarkable confluence for all three, Nierenberg, Salk, Kinzel were graduates of the same high school -- Townsend Harris Hall.

After the war Nierenberg returned to Columbia to finish his degree as quickly as possible. He applied to professor Rabi who almost immediately obtained a National Research Council predoctoral fellowship for him. The memory of this wonderful help spurred him in later life to do the same for future students when he served on the National Science Board. Rabi turned him over to Norman Ramsey where he became the first of Ramsey's many students. The experience and exposure he gained from working with both men was invaluable. His first task was removing five years of dust from Sidney Millman's prewar molecular beam laboratory on the fifth floor of Pupin Hall. His assigned problem was the elucidation of the quadrupole broadened alkali resonances in the alkali halides that he successfully completed in eight months and led to a thirty-five page paper in the Physical Review.

The paper included a "first" in observing a zero field resonance of the molecular quadrupole resonance in the sodium chloride molecule. It had not been attempted before because of the belief that in passing through the zero field the magnetic moments would lose their sense of orientation but yet enough did maintain their original orientation to yield a measurable signal.

His was the second post war PhD in physics at Columbia and his oral committee was an impressive collection. Besides Rabi and Ramsey it included Willis Lamb and Hendryk Kramers. Those were heady times. Kramers was in New York City as a Dutch delegate to the United Nations Assembly and thus a natural for a visiting professorship. This was on the political side. Heitler took his place the following year or so and his presence was coincidental in that it came during the extraordinary burst of renormalization field theory that was coupled to the Kusch-Foley and Nafe Nelson experiments as well as the Lamb experiment. In retrospect it should be looked at as a manifestation of the presence of a remarkable physicist -- I.I. Rabi.

Nierenberg was also then drafted as an instructor to work with professor Shirley Quimby in establishing a new three semester undergraduate course in physics using Sears' new textbook that had been developed at MIT. His fellow teachers were Rainwater, Havens, Henry Foley, Robert Jastrow and Gordon Hughes. Working with Quimby was an experience he never quite forgot. The competition among the junior faculty was quite something. It also included Vernon Hughes, Norman Kroll, Jim Rainwater as well as Jack (John) Nafe and Ed Nelson. Quimby was a poor lecturer in graduate electromagnetic theory but a martinet in supervising his instructors in first year physics. His language was purely nautical and he was immensely distressed when he discovered that none of us could tie a bowline.

The several years after Nierenberg finished his degree probably represented the best physics market ever for a new graduate. He received more than six offers as an assistant professor in good schools but first opted to join Ramsey whom he admired greatly and who was to be the first head of the physics division at the beginning Brookhaven Laboratory. However, when Ramsey suddenly decided to accept an offer from Harvard, Nierenberg reverted to form and started looking for a professorship. Dean George B. Pegram hinted that an offer could be forthcoming from Columbia if he were interested but Nierenberg had decided to leave New York City and Columbia in particular. He did not get along well with Rabi who apparently found Nierenberg overly forward and brash. He was just uncomfortable staying there. It was strange because in relatively short while Rabi became one of Nierenberg's strong supporters and in later years expressed regret that he had not made a real effort to keep Nierenberg at Columbia.

Nierenberg's chief target was the University of California at Berkeley but it was the only one that did not initially reply to Rabi's letter of recommendation. Nierenberg opted for the University of Michigan at Ann Arbor on the basis of its long-term reputation and stability in physics. He was to come under the beneficial influence of such greats as George Uhlenbeck, David Dennison, H.R. Crane and Otto

Laporte. He could not do much in the two years that he was there but he did get a major start in teaching graduate courses because the senior professors were often away at the Institute for Advanced Study in Princeton to catch up on the immediate post war physics developments. In particular, he taught the first year graduate quantum mechanics that he based on Arnold Nordsieck's notes from Columbia that, in turn, were derived from Wolfgang Pauli's Handbuch der Physik article. He was passionately fond of teaching this course and taught it ten more times at Berkeley and once at UCSD. It was a source of great pleasure to him to meet former students many years later who spoke favorably of the course. He quite early incorporated Leonard Schiff's text into the course, which, in its turn was based on Oppenheimer's lectures.

At Ann Arbor he was a leader of a group of young assistant professors in negotiating with the newly formed Atomic Energy Commission to get the financing for repairing and modernizing the valuable cyclotron that James Cork had built and operated before WWII. He also was involved with Crane and Robert Pidd in trying to get the "racetrack synchrotron" going. It never really operated successfully. In addition he started a cosmic ray laboratory based on photographic emulsion techniques. He had very little to show in publications for the two years except for a photo of a more than twenty track star in the latest edition of Cork's nuclear physics text and several theoretical papers that were extensions of his Columbia researches.

Berkeley had finally responded to Rabi's letter but too late for Nierenberg had already accepted the Michigan offer. However, they renewed the offer at the associate professor level and he accepted, feeling that he was going to the Mount Olympia of physics. It was not only a Mount Olympia with names like Ernest Lawrence, Emilio Segré, Luis Alvarez and Edwin MacMillan but it also was a beehive of brilliant younger people who came from everywhere to work at this great center of physics. This list included Wolfgang Panofsky, Harold Brown, Robert Jastrow, Sterling Colgate, Herbert York, John Foster, who each had a positive influence on Nierenberg.

He arrived in Berkeley in the summer of 1950 and immediately was assigned the courses in vector analysis that he transformed into a course in linear physics that included the theory of elasticity, vibrations and the formal aspects of the special and general theories of relativity. In the latter he employed Levi-Civita's text as a source. It was very successful and his notes were used in later years by David Judd and Auriol Ross. The second semester was elective for the majors but it was even better attended than the first. Years later he was invited back for a semester by the then chairman, Trilling, to repeat the course but he declined. This was as a result of the "new" interest of physicists in environmental matters and the awakened realization of the damage that had occurred to their curricula by the elimination of subjects like elasticity and classical optics.

The Nierenbergs bought a modest redwood home but it was on Tamalpais Road where it ended on Shasta Road. The address was number one. It was the "in" street in Berkeley with neighbors like Ernest Lawrence at 111 and, when they retired, the Robert Gordon Sprouls a few doors away. The neighborhood was then populated by the physics department including Francis Jenkins, Robert Thornton, Wilson Powell, Robert Brode and Raymond T. Birge and, eventually, his son Robert. Nierenberg left Berkeley in 1965 and was startled to learn in 1991 that that house was referred to locally as the "Bill Nierenberg" house. It was in the style of a Maybeck home and was often taken for one. When they moved to Berkeley from Ann Arbor they had just their daughter Vicki who was not quite three years old. Their son Nicolas was born in Alta Bates Hospital and was brought up in that home in 1956.

It was at Berkeley that he did his principal academic research. He began by building a molecular beam apparatus patterned after Sidney Millman's machine at Columbia that he had previously used in order to finish three or four ideas that were still pending. His first student was George Bemski who went on to Bell Laboratories where he succeeded in measuring the largest atomic angular momentum ever, using solid state resonance techniques.

Nierenberg's principal objective, however, was the systematic measurement of the spins and magnetic moments of radioactive nuclei. He was somewhat disappointed by the priority established in

Cambridge (UK) by Kenneth Smith with the collaboration of Darragh Naigle, then from MIT and later from Los Alamos. Their measurement was of the spin and hyperfine structure of ^{24}Na. Fortunately, Nierenberg was able to recruit two exceptional students, John Hubbs and Peter Hobson who made order of magnitude advances in technique that made possible systematic measurements on many radioisotopes.

They discovered that the beam-collecting surface used by Smith and Naigle was less than one tenth in collection efficiency and by examining the literature they discovered that a sulfur surface would be better and it turned out to be 100% effective. The second innovation was to count disintegrations using the short path K Xrays that could be completely absorbed in millimeter thick crystals. This enabled counting almost all the disintegrations with the extremely low background of one count a minute. Eventually Nierenberg's atomic beam group measured the properties of about sixty or so radionucleides. About fifty PhD's were earned in this research. Two former students, Howard Shugart and Richard Marrus stayed on as professors and members of the group. Henry Silsbee was early on a vital contributor to the research who left to go to the University of Washington then to SUNY at Upton. At any given time there were about fifteen graduate students working on their degrees, several domestic post doctoral researchers and several overseas guest, among them Kenneth Smith and, later, Ingvar Lindgren from Sweden. The use of radioactive detection released the beamists from the very restrictive use of alkalis imposed by detection requirements. As a result the measurements were far ranging over the periodic table, gallium is a good example. The most interesting departure was the case of the rare earths. It happened that most of the atomic spectroscopic ground states were unknown and some that were listed turned out to be wrong. The normal situation had been where the atomic J value was well known, as in the case of the alkalis, and only the nuclear angular momentum, I, was sought. Where the atomic J as well as the nuclear I values were unknown, enough resonances could be observed to determine both values unambiguously. As a result, the ground states of nearly all the rare earths were determined -- an essential step in deciphering their complex spectra. At the invitation of Glen Seaborg and Isidore Perlman, Nierenberg set up shop in the Chemistry Division of the Lawrence Radiation Laboratory to perform similar measurements on the transuranics. He already was established in the physics division of the laboratory at the direct invitation of Ernest Lawrence who was appreciative of an experimental solution to a vexing vacuum problem on the MTA (Materials Testing Accelerator) that Nierenberg had found that had put the program back on track. Richard Marrus was the prime investigator on the transuranics that also turned out to be very successful in determining J as well as I values.

Nierenberg was also one of the first to use on-line computers in research. It was essential for work on very short-lived isotopes. The first machine employed was the IBM 650, a pitiful representative of what would become a million times more powerful in decades. The program could take initial, low magnetic field results and quickly predict the resonance position at a higher field using minimum sample. After repeating the process with successively higher fields, precision results could be obtained for the hyperfine interaction. In time the software program was refined in successive versions labeled serially as HYPERFINE 1, II, III and IV and was used in other laboratories, Princeton, for example. Calculations to eight or nine significant figures were necessary to estimate the nuclear gyromagnetic ratio directly.

Towards the end of his stay at Berkeley Nierenberg started to branch out into related optical research that was stimulated by Kastler's work on optical pumping and Townse's work on lasers. Tetsuo Hadeishi, a former graduate student, was key in this research that introduced new and powerful techniques in electronic beam strength. It was carried out in a specially built magnetic field-free wooden house in Wildcat Canyon built by the Radiation Lab. It was shared with Kai Siegbahn who needed a similar facility for his B-ray spectrograph.

During his stay in Berkeley, Nierenberg had three major activities separated from his teaching and research. The first was in secret antisubmarine research that had been stimulated by Rabi and Emanuel Piore who then was the civilian head of the Office of Naval Research. The plan was to build a major university laboratory at Columbia University to provide an academic base for developments in the use of long-range low frequency sound in submarine detection. Bell Laboratories had already built an operating array in the ocean that used this principle.

A one week meeting was held at the McMillan theater at Columbia to which had been invited just about every active physicist who was willing to come. The activity had the project name Michael. The decision was made to start the laboratory and E. T. Booth became the founding director after Wolfgang Panofsky turned down the invitation. Nierenberg went east that summer to live in Hastings, NY, to help Booth start the project for a laboratory home had been found in nearby Dobbs Ferry in an unused building on the shore that had originally been a bible factory and most recently a Philips television factory. Besides Nierenberg, Booth was joined by Rainwater and Nafe, among others.

In 1953, when Booth decided to leave, Nierenberg came east for one year to direct the laboratory. While there he developed a novel and successful method to sweep the pressure mine that had been so successfully employed against the Navy in the Korean war. However, it was never used. It was this experience and his continuous interaction with the Navy and later with the White House that gave him sufficient prominence in US oceanographic circles that led to his eventual selection as director of the Scripps Institution of Oceanography. His second avocation, so to speak, was as West Coast Secretary of the American Physical Society. Joseph Kaplan at UCLA had held the job for many years but apparently the power structure was very unhappy with his arranging a meeting at Berkeley concurrently with the American Association for the Advancement of Science. Nierenberg enjoyed this activity very much and was responsible for two meetings a year, a rather large one in winter and a smaller one in summer. It was not a very difficult chore because the pattern of the meetings had been set by the long time national secretary, K.K. Darrow, and deviations from this pattern were not tolerated by Darrow who had very fixed views, to say the least.

Nierenberg introduced several innovations, one of which was the first organized press conference at a physical society meeting. The principle motivation was the very negative feelings generated by the newspapers devoting space to eccentrics like Ehrenhaft whose antics about magnetic monopoles dominated the stories that came out of the big annual meeting in New York City. The press conference immediately before the meeting gave the journalists some guidance as to what was happening in physics. It worked.

Nierenberg never actually took a sabbatical from his professorship. He was diverted from his one opportunity by Frederick Seitz who had been Science Adviser to NATO for eighteen months and had persuaded Nierenberg to be his successor. There was a certain family affair in all this. Norman Ramsey had been the initial incumbent and Rabi had been the initial US representative to the NATO Science Committee that the adviser chaired and was to remain in that position for many years.

NATO was headquartered in Paris then and it was a busy and complicated two years for Nierenberg and his family which now included a teen-aged daughter and a four year old son. In addition to his duties as science adviser (now called Assistant Secretary General of NATO for Scientific Affairs) he had the title of *Professeur Associé* at the University of Paris and was established in professor Alfred Kastler's laboratory at the *École Normale Supérieure* where he had a student from Berkeley, Norman Braslau, who worked on the element Francium. He was also an active participant in the seminar on resonance physics conducted by Kastler and Anatole Abragam at the *Collège de France*. He made four trips back to Berkeley during this period to keep up with the research program there which never lost its momentum while he was on leave.

There were certain personal rewards in this affair at Paris which, after all, was second home to Nierenberg. His French improved so much that he was almost native in its use. The most distressing thing about it was to be taken for a Belgian because of a small residual accent.

One related affair was with Cyrano de Bergerac that he was able to bring to a close using the *Bibliothèque Nationale* which kept an interesting file on Cyrano. While in Dobbs Ferry, he and Edith often went to the theater and opera in NYC. The New York City Repertory Theater, under the direction of Jose Ferrar, redid his famous movie version of Cyrano. When he returned to Berkeley, Nierenberg found an edition of the play wherein Rostand describes Cyrano as *physicien* in a preface. With that as a

start, Nierenberg began a life of the Libertine with an emphasis on his physics that occupied him for years. He delivered it as his professorial lecture later on in La Jolla, as a prize lecture for Phi Beta Kappa and the American Association for the Advancement of Science and for the American Philosophical Society in whose Proceedings a version was published. The lecture also included a beginning of a discussion of Aristotle as an oceanographer. Nierenberg was tracking a two millenium old story that Aristotle had committed suicide by drowning because he was frustrated at not being able to decipher the origin of ocean tides.

Another obsession that actually began while he was with NATO was with Turkey as a country. It started in September, 1960 when AGARD, (Advisory Group for Aeronautical Research and Development) a NATO operation, held a tenth anniversary meeting in Istanbul. He fell in love with the old city and, over a lifetime, he visited the country more than fifteen times, covering just about the entire country in the process. He even learned to speak the language to be able to come closer to its people and customs. Back in NATO he felt his biggest contribution was the expansion and regularization of the NATO Advanced Study Institutes or the *écoles d'été* as the French called them. This program was a continuation of the one started by his predecessors, Fred Seitz and Norman Ramsey. They are still operating to the order of about fifty a year and cover just about every conceivable technical subject at the graduate or post graduate level. They undoubtedly form the most effective scientific interaction at the international level.

The resources afforded by NATO allowed his office to undertake many important initiatives. Among them was the formation of an international organization for operations analysis with the help of Philip Morse. Very early for its time was the sponsorship of studies on chemical taxonomy developed by a colleague, Brian Coleby. His office was concerned about the decrease in taxonomic experts just at the time when environmental considerations were coming to the fore. This was primarily due to the impact of molecular biology. The situation had not improved in 1988 when he was a member of the National Science Board where he initiated a major activity at the board level aimed at preserving species diversity.

This experience in Paris led to a lifelong interest in foreign affairs. For many years he was adviser-at-large to the State Department. He also served essentially permanently as a member of the US delegation to the many Law of the Sea conferences.

The year before he left for Paris, Nierenberg held the position of president of the local chapter of the American Association of University Professors, an organization of which he had been a member for many years. That academic year, 1959-60 could be marked as the beginning of the organized student unrest at Berkeley that peaked in 1964-65. The beginning was marked by the "courthouse steps" incident in San Francisco. The Berkeley chapter of the AAUP transmitted a formal protest on the police behavior over his signature that was peremptorily dismissed by mayor Christopher. As Nierenberg later observed, the faculty learned nothing from the incident and thus was totally unprepared for the Free Speech Movement that they could have beneficially controlled.

This was not his only political activity in that period. During the Goldwater campaign he was the Northern Californian chairman of the Scientists and Engineers for Johnson and Humphrey's organization. Harold Urey was the Southern California chairman and both had been named by Jerome Wiesner who had been John F. Kennedy's science adviser. He was aided by Owen and Babette Chamberlain and the effort was very successful. President Johnson recognized the principals at an Oval Office ceremony.

The success was measured by the recognition of the growing influence of the scientist in national affaires but this glow was soon tempered in the academic community by the disenchantment with the Johnson administration's handling of the Viet Nam war. Nierenberg had expressed open concern about the strong identification of the technical community with President Johnson's campaign but the concern over what seemed to be the reckless Goldwater platform overrode this apprehension.

The Jason group of physicists was formed in 1959 under the intellectual sponsorship of a scattered group of leading physicists like Eugene Wigner, John Wheeler and Charles Townes. Nierenberg did not join the group immediately, however, because of his two years with NATO in Paris. On his return he became an active member of the group until his age put him in the inactive senior advisor status in 1990. In one period, he served six years as the leader of the Jasons, that is chairman of the Steering Committee.

His most significant accomplishment in Jason was as the leader of the working group that developed the "Electronic Barrier" in the Viet Nam war. It was never used as intended but it was the key to the lifting the siege of Ke San. He also led an important working group that functioned as the Red Team against the various MX basing proposals. One result was membership on the secretary of defenses MX basing panel, chaired by Charles Townes, where he and one other member were the minority vote against the entire program. This was not consistent with his colleagues' view of him as a fixed conservative but he seemed to work hard at trying to maintain a detached technical attitude in the very bitter debates in such programs associated with global warming, acid rain, the MX and ultimately Star Wars.

The transfer from physics professor to the directorship of the Scripps Institution of Oceanography in La Jolla was not as difficult as might be imagined. For one, it was part of the same university with the same high academic standards. It was essentially a graduate school/research institution that matched his previous professional life. It was as if he had deliberately prepared for the change, starting with his aborted thesis program with Biot and his ASW activities coupled with his leadership of the Hudson Laboratory. As West Coast Secretary of the American Physical Society he had specifically arranged for papers in geophysics and oceanography that were given by Roger Revelle, Columbus Iselin and Freeman Gilbert, among others.

In addition, he had worked closely with John Isaacs on the NAS Mine Advisory Committee and had had association with Carl Eckart and Walter Munk. In fact a few years after his return to Berkeley from the Hudson Laboratory, Nierenberg was offered the directorship of the Marine Physical Laboratory, then the major part of the Scripps Institution of Oceanography. The offer was made by Carl Eckart accompanied by Arnold Nordsieck at a meeting in Berkeley. It was a private joke that he shared with Walter Munk that, had he accepted, he would never had been appointed director of SIO, the politics being what it was.

Had Nierenberg been more astute politically he would have hesitated a lot longer before accepting the directorship of the Scripps Institution of Oceanography. One of the more important reasons he had for leaving nuclear physics for oceanography was the explosion of physics into "big business". The golden years of the field in the United States were 1945-1965. The field had kept its relatively isolated and simple intellectual character. However, at the end of this period it had grown to be big business with a huge imbedded bureaucracy wherever one turned in government and even in the American Physical Society and the Institute of Physics. There were all sorts of changes. In the early years there were no registration fees at meetings and officers of the American Physical Society served without remuneration. Financial competition for the better students arose. Schools that never had any great graduate interest in the subject started to use political lobbying tactics to obtain government funding and, worst of all, facilities were awarded on a non-merit and non-competitive basis. A very well kept secret is how many National Science Foundation awards are made outside the much vaunted peer review system. Most psychologically debilitating, however, is how much more paper has to be written for government grants between the two dates.

All of this and more gave a repetitive character to one's research. To this point Nierenberg had published about one hundred papers and about five review articles in his major field. He had seen about forty students through to the PhD and his associates in his laboratory had brought out about forty more. He could only see an indefinite future of the same and oceanography seemed, at the time, more like the "small" science he had once so enjoyed and embraced. Unfortunately, not then being immersed in the

field, he was unaware of the major efforts in Washington to accelerate the subject to match the level of activity of physics and other sciences. A White House Science Adviser's panel on oceanography was already underway to develop an expansion policy for the field. Legislation to form what was to be known as the Stratton Commission was being prepared. There had been earlier efforts by the Office of Naval Research in this regard, particularly the TENOC program. These developments plus a whole host of others such as the statutory formation of NOAA (the National Ocean and Atmospheric Administration), NACOA (the National Advisory Committee on the Oceans and Atmosphere), The Sea Grant Program, the National Science Foundation's oceanography program all rapidly transformed the field to where it was little different in nature to what existed in physics albeit on a smaller budgetary scale. There was even an equivalent to the SSC in the form of the MOHOLE adventure that went to a fate that, unfortunately was to be followed by the big accelerator.

What Nierenberg met when he arrived in La Jolla was a divided and confused leadership. Due to Revelle's extended absences, the institution developed into a kind of structural barony whose parts were headed by John Isaacs, Walter Munk, Fred Noel Spiess and Per Scholander along with somewhat lesser ones like Douglas Inman's inshore group. There were also "headless" divisions as in Marine Biology. An excellent director for the institution could have been chosen from among this group but the polarization was such that it was necessary to go outside.

There were two system problems that existed when he arrived. The first was the anomaly that SIO, the venerable institution that had a formal existence since 1903, had no specific representation within the brand new campus, UCSD. Beyond its research divisions, it consisted of a patchwork of three departments that could each give the PhD in its discipline. SIO was not a formal part of the UCSD Senate nor had it a designated faculty structure. This had to be and was corrected within the first two years along with the recognition of the interdisciplinary character of the research at SIO by fusing the three departments into one with the simple non-descriptive title of the Department of the Scripps Institution of Oceanography.

The second problem was instrumentation. Having come from Berkeley and the Lawrence Radiation Laboratory, he was taken aback by the primitive state of the computational facilities, even in the relatively advanced Marine Physical Laboratory. He devoted much effort in bringing the laboratory to the state of the art in on-line computing particularly on board the research vessels. He was able to enlist the invaluable help of IBM using the 1800 with its sophisticated system of interrupts, for example.

Because of the inherited confused situation at SIO, the financial affairs were quite muddled. There were adequate funds for any reasonable initiative but they were so scattered that it had been impossible to activate any initiatives. Almost immediately it became apparent that the institution could easily double the number of students from ninety to approximately one hundred eighty and, with the assistance of the department chairman, Warren Wooster, it was accomplished over the next few years. The number remains at that level more because of personnel saturation than financial restrictions.

Even more daunting was the initiation of the Deep Sea Drilling Project. After several aborted starts, the Woods Hole Oceanographic Institution, the Lamont Geophysical Laboratory, the Miami School of Oceanography along with SIO organized the JOIDES group (Joint Oceanographic Institute for Deep Ocean Drilling -- a name probably due to Arthur Maxwell) to sample the deep ocean sediments world wide. This to be done in the very shadow of the just collapsed MOHOLE project!

This assignment was also part of Nierenberg's initiation as director. Shortly before he arrived it had been agreed by all the institutions that SIO be the lead organization in its prosecution. By this action Nierenberg became, the de facto, and, eventually, the official principal investigator of a project that was to begin at a level of twelve million dollars for the first eighteen months of drilling. About seven versions of the proposal had to be written to a National Science Foundation that still had not recovered from the shock of the MOHOLE debacle and which did not have the full complement of funds for the first drilling term. It was less than a year from the signing of the contract that a fully equipped drilling ship, D/V

Glomar Challenger was on its trial run. From that day, ***, to today, the project has operated without adverse incident in much the same mode although the worn-out Challenger has since been replaced by ***. The work resulting from these cruises coupled with the parallel developments in marine geology undoubtedly represent one of the major scientific advances of the twentieth century.

A few years before Nierenberg had come to Scripps, it had been the host institution for a major study on non-acoustic detection of submarines. Many distinguished physicists attended such as Edward Purcell, Erwin Hahn as well members of the SIO staff. This left a residual inheritance as the Applied Ocean Laboratory (AOL) and a DC3 that had been donated to the Institution by the company that had operated it for the program. The problems of management of the aircraft, the clear value of aircraft in oceanic research and a long-held desire to be a pilot stimulated Nierenberg to get his own license to fly and he eventually reached the level of instructor in instrument flying as well holding a pilot ticket for multi-engine aircraft. For a period he had his own twin Cessna 310.

As mentioned earlier there were important initiatives undertaken in this period with regard to the environment in general and oceanography in particular. NOAA, the EPA and the CEQ (Council on Environmental Quality) were simultaneously created by executive order by President Nixon early in his administration. Nierenberg was offered the post of Administrator of NOAA but declined in favor of Robert White. In fact, he was offered the position two more times by subsequent administrations. However, he did become the founding chairman of NACOA, a presidential committee. Not long after, he became the founding chairman of the NAC (NASA Advisory Council). This was a natural appointment for he had long been a pioneer in the remote sensing of the oceans and had established a major installation at SIO to pursue this objective. It was closely related to his establishment of a major initiative in climate based on the earlier work that had been stimulated by the CALCOFI program paralleling the devastating failure of the California sardine fishery.

The climate program was also designed as a natural development following the California sardine fishery failure but also as a concomitant part of the CO2 climate change program that had started with Revelle and Seuss and C.D. Keeling. He induced Jerome Namias to come to SIO to be the central figure in this short-term climate change and prediction program. One result of this involvement was the chairmanship of a major National Academy of Sciences effort on climate change. The report, issued in 1983 was a standard reference for many years.

Because of his close association with the Deep Sea Drilling Project and the other environmental matters he was invited to serve on the National Science Board, which he did for two terms.

Nierenberg never lost interest in matters of national defense. For one thing, it was hard to avoid as director of the Scripps Institution of Oceanography, given the important role played by the US Navy in the support of oceanography. The major vessels in the SIO research fleet were built and owned by the Navy, for example. Among his various appointments were service on the Defense Science Board and the Strategic Defense Initiative Office (SDIO) Advisory Committee.

The success of the National Academy of Sciences report on climate change induced the White House to appoint him as chairman of a special committee on acid rain at a time when relations between the United States and Canada were badly strained over the issue. The report was effective in defusing the disagreement for the time being, taking a middle course as it did. This was a continuing subject for Nierenberg and he served later as a member of the Oversight Review Board (ORB) for NAPAP, the National Assessment Program on Acid Precipitation, a congressionally mandated affair. These specific environmental questions, acid rain, global warming, species protection, preservation of the whales -- absorbed most of his post retirement activities.

One result was involvement in the production of encyclopedias. The success of his prize winning Encyclopedia on Earth Science Systems encouraged him to undertake a much more ambition one on environmental biology. His combined experiences in NATO and the NSB on the preservation of species,

on the global warming problem and the acid rain problem made him realize that the weakest link in the scientific elucidation of these problems was the fragmented knowledge of the environmental biological and physiological effects of these anthropogenic excesses. A central source was badly needed not only for the scientists but also for public arenas like state capitals, city halls as well as corporate offices and involved citizen groups.

As Director of Scripps Institution of Oceanography Nierenberg was host to major international figures. The most relevant was Emperor Hirohito of Japan. The emperor was well known in ocean science circles as a practicing marine biologist who had published several beautifully illustrated monographs on fishes. He also maintained a small yacht equipped for biological research. When it was announced that the Emperor and his wife would visit the United States, it was clear that he would spend some time at Scripps Institution of Oceanography. In fact it was the only reason for their visit to San Diego.

The even more exciting visit to the institution was that of Queen Elizabeth of Great Britain on the royal yacht Britannica. The royal couple spent an hour reviewing salient features of the institution's program. It was first believed that the choice of SIO was to emphasize the Duke of Edinburgh's role as the president of the World Wild Life Society but it turned out that it was on the recommendation of Crispin Tikell who was then ambassador to Mexico. He reported that the Scripps Institution of Oceanography was the only establishment worth visiting in San Diego!

One of the first visits of heads of state or near heads of state was that of Prince Souvanna Phouma of Laos. It was followed by two vice presidents of the United States and the Crown Prince of Jordan. Nierenberg always was cynically suspicious of the reason for these distinguished visits. It appeared to him that, with the exception of the Emperor of Japan, it was for public image creating purposes as a combination of environmental seriousness coupled with splendid photo opportunities for the media. This was certainly true of vice president Humphrey. In Vice President's Agnew's case, it probably was an excuse to get to Palm Springs to play golf.

There were many local issues as well. One of the earliest encountered was the matter of underwater parks. This was a subject that had engaged the interest of many concerned citizens in California but with very little to show for their efforts. Mayor Pete Wilson called on Nierenberg to chair a committee to develop a specific proposal off the La Jolla Shores. Working with city officials, the park was made viable in about three years and it has become a valuable environmental feature of San Diego.

Nierenberg retired from the directorship in 1986 and the physical oceanography and space science building on the Scripps campus was renamed Nierenberg Hall a year later. Governor Pete Wilson was the principal speaker at the dedication ceremony. The governor and Nierenberg had worked together on environmental issues almost from the first day that of Nierenberg's directorship and when Wilson was a beginning member of the state legislature. Wilson's interest in environmental issues brought him to SIO on his own initiative. Specifically they worked together to bring the coastal initiative to fruition in that period. Later on they were joined by Mayor Roger Hedgecock in pursuing the same goals. Hedgecock was a principal speaker at Nierenberg's sixty-fifth birthday party and reminisced about their success in environmental issues.