Honoring Laymon N. Miller

Colleague, Mentor, Friend and Gentleman

169th Meeting of the Acoustical Society of America

MONDAY AFTERNOON, 18 MAY 2015 COMMONWEALTH 2, 2:00 P.M. TO 4:25 P.M.

Session 1pAAb

Architectural Acoustics, Noise, and Structural Acoustics and Vibration: **Session in Honor of Laymon Miller**

Neil T. Shade, Cochair
Acoustical Design Collaborative, Ltd, 7509 Lhirondelle Club Road, Ruxton, MD 21204

Bennett M. Brooks, Cochair
Brooks Acoustics Corporation, 30 Lafayette Square - Suite 103, Vernon, CT 06066

Chair's Introduction—2:00

Invited Papers

2:05

1pAAb1. Family and life experiences with Laymon. Robert L. Miller (Harris Miller Miller & Hanson Inc., 77 South Bedford St., Burlington, MA 01803, rmiller@hmmh.com)

This talk will bring to light memorable personal recollections growing up with Laymon as husband, father, and mentor. My own memories will illustrate how his love of acoustics, the people he worked with, and the problems he worked on ultimately led to my own career in acoustics. They will include a recounting of childhood business trips, flying experiences, and a summer job opportunity at Bolt Beranek and Newman. The talk also will include his wife, Lucy's, still-vivid recollections of Laymon's first years at the Harvard Underwater Sound Lab, his nine years at Penn State, and many years later their times together as she accompanied him on his BBN lecture series. Unpublished excerpts from Laymon's five-volume autobiography will be used to illustrate his own detailed and insightful accounting of other family and life experiences, including his own "ethical will," written for later generations to better understand and appreciate the values and beliefs for which he most wanted to be remembered.

2:25

1pAAb2. Laymon Miller, distinguished consultant in noise control engineering at Bolt Beranek and Newman. Leo Beranek (Consultant in Acoust., 10 Longwood Dr., Westwood, MA 02090, beranekleo@ieee.org)

Laymon Miller was employed in Harvard's Underwater Sound Lab (HUSL), under the direction of Professor F. V. Hunt during World War ll. When that laboratory closed, Laymon joined the consulting staff at Bolt Beranek and Newman (BBN). Laymon became BBN's leading expert on the reduction of noise and vibration in ventilating systems. One of his important jobs was noise reduction at New York's Lincoln Center's Philharmonic Hall. He also became expert in vibrations transmitted through the earth. In particular, he designed the vibration isolation pads used to reduce the transmission of railroad track vibrations into adjacent buildings in a number of cities, including Boston's Back Bay and Montreal. Practically every important building acoustics project that came into BBN received his attention. He gained the reputation of more chargeable consulting time each month than any other employee. Besides mentoring numerous new BBN employees he taught highly sought after courses on noise reduction for architects, building, industrial and plant engineers, as well as for other acoustical consultants.

2:45

1pAAb3. Reminiscences on Laymon Miller's remarkable twenty seven year consulting career at Bolt Beranek and Newman in Cambridge. William J. Cavanaugh (Cavanaugh Tocci Assoc. Inc., 3 Merifield Ln., Natick, MA 01760-5520, wcavanaugh@cavtocci.com)

Laymon Miller joined the noise control engineering consulting staff of Bolt Beranek and Newman (BBN) on August 1, 1954, bringing an impressive record of experience in acoustics from Harvard University's top secret Underwater Sound Lab (HUSL) during WWll followed by ten years as head of the acoustics section at Penn State's Ordinance Research Lab (ORL). Laymon provided invaluable mentoring for many new BBN consulting staff members like this author whose only experience in acoustics were introductory courses in architectural acoustics taught by Physics Professor Richard Bolt at MIT's School of Architecture and the MIT Acoustics Lab, Laymon quickly established a reputation among BBN employees and clients alike as an outstanding teacher and contributed to BBN's unofficial title as the "third important graduate school in Cambridge." He documented his diverse consulting career through numerous technical papers and articles, through technical brochures he prepared for clients like the US Army Corps of Engineers, manufactures like the Baltimore Air Coil Company and through reports he prepared for thousands of BBN projects on which he served as principal consultant. Laymon retired from BBN in 1981 after a remarkable 27 year career making quieter buildings, concert halls, workplaces, communities, transportation vehicles, and in general, "the world a better place."

3:05

1pAAb4. Laymon N. Miller—Contributions to industrial and community noise control. Eric W. Wood (Acentech, 33 Moulton St., Cambridge, MA 02138, ewood@acentech.com)

Laymon N. Miller, following graduation in 1939 from the University of Texas in Austin, spent time first at the Underwater Sound Lab at Harvard University and then at Penn State as Head of the Acoustics Section of Ordnance Research Lab (ORL). In 1954, he joined Bolt Beranek and Newman where he was honored as their first Principal Consultant. This presentation describes his contributions to industrial and community noise control while consulting for a wide range of many clients for 27 years, until his retirement in 1981. Laymon Miller, a gentleman, friend, and colleague.

3:25

1pAAb5. Origin and history of the Laymon Miller noise course. Reginald H. Keith (Hoover & Keith Inc., 11381 Meadowglen Ln., Ste.. I, Houston, TX 77082, reggie.keith@hoover-keith.com)

For 20 years, starting in 1969, Laymon Miller produced and taught a seminal course in noise and vibration control in many different venues and settings. In this paper, I will present information as to the origins of this course, my recollections of first attending the course in 1977, and our experiences in the continuation of the course since 1989.

3:45

1pAAb6. Laymon Miller—An exemplary acoustical consultant. Bennett M. Brooks (Brooks Acoust. Corp., 30 Lafayette Square - Ste. 103, Vernon, CT 06066, bbrooks@brooksacoustics.com)

Laymon Miller was a “Consultant’s consultant.” He embodied a wonderful example of how to conduct oneself in the engineering consulting business, providing leadership in defining the functions and responsibilities of acoustical consultants. As a leader of our profession, Laymon was also a great friend to the National Council of Acoustical Consultants (NCAC). Former NCAC Newsletter Editor Bill Cavanaugh asked Laymon if he would serve as a guest editor for a continuing series tentatively titled “War stories …from the Consulting Veteran’s files.” Laymon answered the call, and this series continued for many years, capturing the “priceless gems” from which all of us, at all experience levels, can learn about the problems faced by consultants, and importantly about the solutions as applied in the field. Laymon was a talented and generous teacher, in print and in person, of those inside and outside of acoustical consulting. His experiences, related with insight and humor, have provided guidance to generations of those in general industry and to acoustical consulting practitioners alike. Laymon was elected an Honorary Member of NCAC in 1993, received the NCAC C. Paul Boner Award in 2007 and was presented the Institute of Noise Control Engineering (INCE) Outstanding Educator Award in 2008.

4:05

1pAAb7. Experiences as editor of Laymon Miller’s book An NCAC Anthology in Noise and Vibration. Neil T. Shade (Acoust. Design Collaborative, Ltd., 7509 LHirondelle Club Rd., Ruxton, MD 21204, nts@akustx.com)

This presentation will recount the experiences of serving as editor of Laymon Miller’s book, An NCAC Anthology in Noise and Vibration, published in 2013 by the National Council of Acoustical Consultant’s (NCAC). Ever active in retirement, and at the behest of William Cavanaugh, Laymon contributed 60 papers from 1996 to 2012 to the NCAC Newsletter. These papers, along with his industry publications from 1957 to 2008, were the basis for his book. A committee was formed within NCAC to oversee the compilation and production of his book with this author serving as editor. The “engineer” in Laymon was evident in the meticulous organization of his writings and instructions provided to the editor. An NCAC Anthology in Noise and Vibration is organized in two parts. The first contains industry publications, arranged by topic. The second is Laymon’s NCAC articles arranged chronologically. The book concludes with his autobiography, which he humbly described “as a life of surprises.” Laymon dedicated his book to his friend and colleague Leo Beranek. Through editing the book the author gained insight into Laymon’s seminal contributions to building acoustics, noise and vibration control, community noise, his acoustic consulting adventures, and the work ethic of this remarkable man.

Slides and text prepared and presented by Bob Miller

FAMILY AND LIFE EXPERIENCES WITH LAYMON

Robert L. Miller

Oral Presentation at a Special Session of the
Acoustical Society of America
18 May 2015

Before I get started, I'd like to welcome a few family members who are able to be here – my brother, Arthur, and his wife, Nancy from Columbus Ohio. My oldest daughter, Lindsay Tomko, is also here. I'm proud to say she worked for a summer at HMMH and later semesters at General Electric and Pratt & Whitney on jet engine failure analyses while she attended Carnegie Mellon here in Pittsburgh. Lindsay now works at Bechtel on failed submarine components in nearby Monroeville.

As for me, though I've been a member of the Acoustical Society for more than 30 years now, I was never as prolific a writer or presenter as dad, so to the degree I know any of you, it's very likely through my parents, or perhaps less likely through my own 9 years at BBN or now 34 years at HMMH. What I hope to do this afternoon in any case, is relate a few of my fond memories of Laymon – Dad -- as I grew up and ultimately worked in the same office with him, though only rarely on the same project. Nevertheless, in his unassuming calm way, he clearly had an enormous influence on my life.

Earliest Memories – Penn State Days

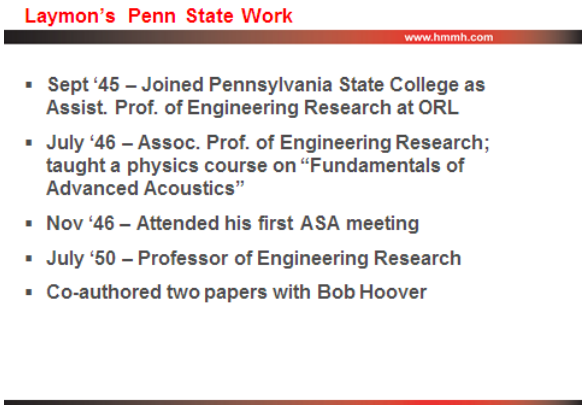
My earliest vivid memory of dad was about a year after this 1946 picture when he was at Penn State. We had moved into a new duplex, and our neighbors had a son, Dickie Lassman, who was my age and whose father worked as a Lab Technician at the Ordinance Research Lab. One afternoon as we played in the back yard under mom's watchful eye, a slightly familiar-looking pirate in khaki pants, one leg lopped off at the knee, a patch over his eye, and a red bandana tied around his head, hobbled on a crutch out of the field behind our house. The pirate showed us an old crumpled map he'd found with an "X" marking the spot where he was sure a valuable treasure had been buried but he needed help finding it. Failing to see the pirate's second leg tied behind him, Dickie and I followed the old pirate along the map's windy path, past a rendition of Mount Nittany off in the distance, but

ultimately leading to the "X", where, lo and behold, we dug down and found a bag of candy. Dad enjoyed the ruse as much as we did and at age 85, recounted a nearly identical version of the story in his five-volume autobiography.

My First Train Set at 3½

Other early memories from State College often revolved around Christmas. Nearly every year Dad would spend many late night hours making a new toy. His first and most elaborate was an operating fire truck made from scraps of metal and hose left around the lab. Beginning with a spare cylindrical can used for "Depth and Roll" recorders used in Dad's work with torpedoes, he fabricated a metal chassis to support the tank; a geared axle connected the wheels to a steering wheel in the front seat. The wheels themselves were metal and milled to give them a knurled surface, then painted black to look like tires. To the water tank, he mounted a removable bicycle valve where water could be added and then pressurized with a bicycle pump. A short hose with a nozzle and cut-off valve was connected to the bottom rear of the tank, and a fire-engine red coat of paint completed the engineered work of art. At 2½, I could never appreciate all the time and effort that went into creating it.

A year later, Dad made my first train set. His dad had given him a Lionel set when he was 7 or 8 and he couldn't wait to start one for me. Dad expanded it each year, eventually adding a second independent track for a passenger train so Art and I could play with them at the same time. Only a few years ago did I trade in my American Flyer engine and cars for a large expansion of the HO set I had started for my oldest son, Bryce, when he was about 8, though admittedly the train is far more mine than his nowadays.



We had moved to State College in late 1945 so Dad and many of his colleagues from the Harvard Underwater Sound Lab could continue their wartime work on torpedoes at Penn State's Ordinance Research Lab (now the Applied Research Lab). Considering today's occasion, Mom suggested I describe Dad's rendition of his first Acoustical Society meeting. It was November 1946, and like many of his other life events, it, too, was captured in his autobiography. The Editor of JASA at the time was Floyd Firestone; and members of the Executive Council included Leo Beranek and Dick Bolt. The meeting took place in Chicago, and Dad made sure to point out that the Registration for the conference was free! The banquet had 105 attendees (which he verified by counting the faces in the official banquet picture), and the cost of the dinner was $5. The entire conference program was 20 to 24 pages, which he pointed out was shorter than just the instructions for attending the Society's 2001 Annual Meeting contained in its 240-page program. Known for attention to detail, Dad's account at least confirmed a healthy growth rate and bright future for the organization.

It's also worth noting for Reggie's benefit that Bob Hoover had joined the ORL Acoustics Group sometime in the late '40s when Penn State was building the world's largest water tunnel. Bob and Dad worked on a filtering section that would remove noise from a deaerator, and that began a long and close professional relationship that continued at BBN and beyond.

Mk 40 Acoustic Homing Torpedo at ORL

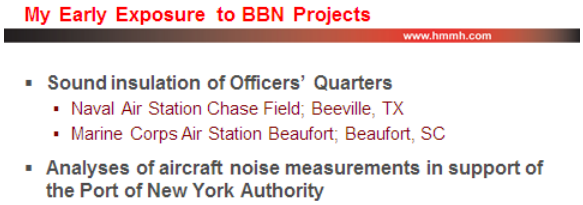
Much of Dad's work at ORL was devoted to reducing the self-noise and enhancing the tracking capabilities of the Navy's Mark 20 Acoustic Homing Torpedo. I remember coming to the lab any number of times and being impressed by the long yellow body of the Mark 20, burnished propellers lying on work benches, and a bevy of machine tools that lined the walls. For a 6 or 7 year old kid, that was exciting by itself but the other reason to visit Dad was that practically every trip also included a stop at "The Creamery". Penn State was very much an agricultural institution at the time and maintained a large dairy farm; the ice cream they produced was indescribably rich and delicious and well worth every trip to get some.

Another benefit arising from Dad's connection to the Lab occurred when he convinced several able–bodied seamen to load a used Mark 20 shipping create onto one of the Navy's flatbed trucks and deliver it to the field behind our new house. Resting on a pair of logs with a door cut in the side and plywood partitions to create rooms, the greatly elongated crate provided years of clubhouse activity and fun play for Art and me.

Many years later, during a visit to State College, Dad heard rumors that a book had been published by the Penn State Press on the early history of torpedo development. Out of curiosity, he and an old friend from ORL, Paul Ebaugh, decided to go to the press offices and there discovered that the book had been written by a Penn State English Professor, Robert Gannon. Entitled "Hellions of the Deep; the Development of American Torpedoes in World War II", it recounted the dramatic history of much of the Navy's early work on torpedo design and testing. Leafing through the chapters, Dad became more and more interested and turned to the first page. The book's opening sentence read "Laymon Miller was typical." It went on to explain that, as a 23-year-old Ph.D candidate from the University of Texas at Austin, he was isolated. People in Washington knew there was a war coming, but international politics, he felt, didn't have much to do with him. That was what was "typical", but how wrong that turned out to be.

Dad's work at Penn State culminated in 1954. He had received a letter from Leo Beranek asking if he would consider working for BBN. The firm was growing rapidly and Dad's reputation in acoustics was becoming well known. Complicating the

situation, Mom had come down with a horrible case of infectious hepatitis and mononucleosis that winter which kept her bedridden for most of nine months; her parents had to come out from Bronxville to live with us while Dad was in Cambridge for the interview. Apparently it went well, however – Dad became employee number 14 and the rest is, as they say, history, much of which you will hear about later in the session.



As Dad settled into his BBN work routine and I reached high school age, he began looking for opportunities to take me on several field trips. My first was a measurement trip to Naval Air Station Chase Field in Beeville, Texas, and from there to Marine Corps Air Station Beaufort in Beaufort, South Carolina. The Navy wanted to develop new construction guidelines to reduce the intrusion of aircraft noise in on-base housing units.

Later, Dad took me on as a summer intern to help analyze data for use in defending the Port of New York Authority (now the Port Authority of New York and New Jersey) in a lawsuit brought by Hempstead County over aircraft noise from Idlewilde Airport (now JFK). It was an honor to be working on such an important case.

Jumping ahead a few years -- following college, a stint in the Air Force, and three months of traveling, searching, and eventually returning to our family island in Canada, I was in the cookhouse washing dishes with Dad when he asked if I'd

decided on a career direction, and I had to admit no. He said BBN was hiring and wondered if I'd be interested in going back there full time. I told him I didn't want to work as hard as he'd done; there were many days I felt I never saw him; I wanted a better balance of work and family. He told me the reason he worked as hard as he did was that he loved it so much. I wasn't convinced, but of course I went back to Weston, interviewed at BBN with Bob Bruce, Grant Anderson and Andy Harris and the rest of that is history, too.

25 Years Working at BBN

www.hmmh.com

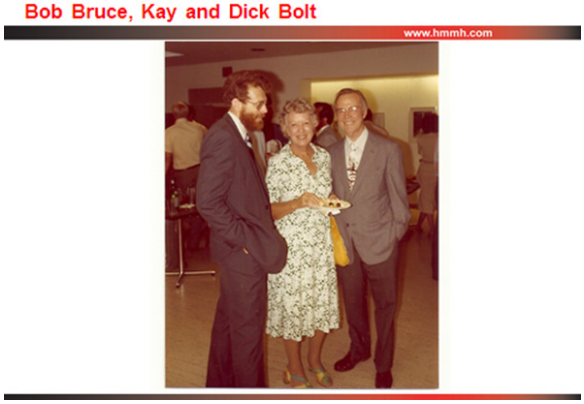
Dad truly did love his work at BBN and he was treated well. But it wasn't just about the work; it was also about the people he worked ***with***, and these are only a few.

But It's about the People, too

www.hmmh.com

Bob Bruce with Laymon and Lucy

Bob Bruce, Kay and Dick Bolt



Bob Newman, Ed Kerwin

Eric Wood, Andy Harris, and many more not shown

Again, quoting from his memoire, "Our last few weeks in Weston and at BBN were surely bittersweet. We were glad to be retiring and moving, but we were continually saddened at the thought of leaving so many friends and associates."

Osawa and Dad's Ethical Will

Which brings me back to Osawa and Dad's "Ethical Will", patterned after Dr. Andrew Weil's concept that "An ordinary will…mainly concerns the disposition of your material possessions. An ethical will has to do with non-material gifts; the values and life lessons that you wish to leave to others." Again, from his autobiography:

Dad cites the gifts – the best qualities -- his parents left him. Dad was a gentleman.

The Excitement and Fulfillment of Education -- When you are prepared, things come to you.

A Professional Pursuit – Choose wisely, pursue your own dreams and interests, and make it a terrific, thrilling, lifetime experience.

Take the time to enjoy nature – the simplicity of a rock…

Enjoy the Simplicity of a Rock

…the peacefulness of a sunset.

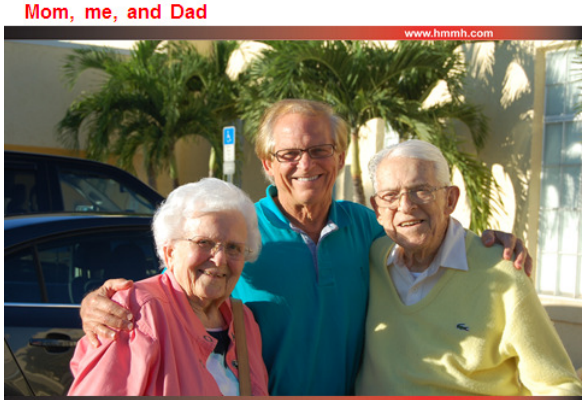
Take the Time to Watch a Sunset

Ponder a day's happy memories with congenial friends and associates at work or play.

Enjoy Happy Memories with Friends at Play

Value family.

Mom, me, and Dad



Art, Lucy Lee, Dad and Mom

And with Lucy on their 71st Wedding Anniversary

I'd like to close with a few comments from mom. I'd asked her if she wanted me to say anything for her, and this is what she wrote.

"How I wish I could be with you right now. Laymon's most admired friends (mine, too!) are remembering him at this meeting of the Acoustical Society of America. I know how humbled and honored he would be to even dream of such a tribute. He might think back to the 1936 newly published textbook, in his second year of advanced college physics, which had all of 11 pages of 'wave motion' covering the Doppler effect, harmonics, and the frequencies of the piano keyboard. The speed of sound (in air only) was discussed. So Laymon said 'he thought he knew some physics back then, but made no claim on acoustics.'

"In 1954, Laymon became employee number 14 at BBN. Ira Dyer was his supervisor. His first jobs were the (then) new problems of noise control of wind tunnels for large aircraft engines. I remember Laymon saying: 'I'm not worth the salary I'm getting' and then going back to read and study everything he could get his hands on. Ten years later, he was given the title of Principle Consultant. This developing field of acoustics became his great joy and challenge. His clients came with all types of noise problems, and Laymon collected data from each one. Eventually those experiences led to broad interest in the field and a desire to share it with many others.

"When BBN awarded him a 6-month sabbatical every five years, Laymon was persuaded to develop a course for the growing needs of consultants, architects and engineers in our country and Canada. After several years of planning, organizing data, 600 pounds of equipment, and writing two textbooks in beginning acoustics, as well as finishing up his own consulting, travel needs, and plans at home, we were ready.

"On September 3rd, 1969 we left on our 15,000 mile journey, pulling our Airstream, for courses in five cities (and some planning time in the Grand Tetons). We returned home on December 14th. As we crossed the Tappan Zee Bridge on our last day, we had some snow. As we stopped to pay our toll, the collector said: 'The man ahead of you says 'Welcome home!' and has paid your toll.'

"The courses led to many individual ones -- to OSHA, the Department of Transportation, and many companies as well as his own series. I was grateful for being able to help the courses run even more smoothly, for learning through osmosis much more about acoustics, and for working with my husband and creating a lifetime of memories during those 20+ years of 'noise control', enriching our years of marriage.

I thank each one of you for your kindness, thoughtfulness, and friendships.

Lucy"

And I thank you as well.

Slides and text prepared by Leo Beranek and presented by Bill Cavanaugh

Laymon Miller and His Work Together With Leo Beranek at BBN.

LEO L. BERANEK
10 LONGWOOD DRIVE
WESTWOOD, MA 02090
beranekleo@ieee.org

MEASUREMENTS AT BOEING, JAN. 1957
AUSTIN TOBIN, JOHN WILEY AND LEO

AT ORLY AIRPORT, PARIS, MAR. 1957 DISCUSSING CARAVELLE TAKEOFFS

PREPARING TO FLY IN PIASECKI HELICOPTER , 1960

LAYMON MILLER, *PRINCIPAL CONSULTANT* AND LEO BERANEK (SEPTEMBER 1979)

LUCY AND LAYMON, 1993

Laymon Miller and his work together with Leo Beranek at BBN.

[PAPER TO BE READ BY BILL CAVANAUGH]

I became acquainted with Laymon Miller in about 1945. He was then working in Harvard's Underwater Acoustics Laboratory (HUAL) that was under the direction of Prof. F. V. Hunt. Laymon had come to Harvard from the Physics Department at the University of Texas in Austin. Several others from that physics department were working with me at Harvard's Electro-Acoustics Laboratory (EAL). Laymon and his wife Lucy and other Texas alumni, sometimes including me, got together for meals and parties. At the end of World War II, Laymon and Lucy moved with others from Cambridge to Penn State University

to work in its newly formed Ordnance Research Laboratory.

In the summer of 1953, Laymon enrolled in a two-week long Special Summer Program on Noise Reduction at the Massachusetts institute of Technology. I was the instructor in charge and I selected the lecturers and chose the sequence of topics. This was the first of four summers that the course was offered and I tried hard to spot the best of the 113 students. Of course, my previous acquaintance with Laymon at Harvard resulted in our having several chats.

We at Bolt Beranek and Newman were receiving an increasing number of contracts to provide noise control in schools, auditoriums, offices and public buildings. Laymon came to mind as an ideal addition to our staff. In April 1954, I wrote

to him asking him to come to Cambridge for an interview. He came, accepted our job offer, and was BBN's fourteenth employee. He, Lucy, and children moved to Weston Massachusetts in September.

In his first couple of years at BBN, Laymon was involved with noise reduction in wind tunnels and in cooling towers. He had to make noise measurements in the field and this meant that, working with George Kamperman, he put together noise measuring equipment that was stable, accurate and whose calibration could be checked in the field. One of the big additions to this measuring setup was an audio tape recorder that I had discovered during a trip to Switzerland. It was compact, rugged, and 100% dependable in the field.

BBN received a contract from the Port Authority of New York (PNYA), (now called the Port Authority of New York and New Jersey) to measure the noise of airplanes taking off from the principle runway at Idlewild Airport (now called the JFK Airport). The Port operates the largest airports in New York State and New Jersey. The reason for the noise measurements was to prepare the Authority for a possible lawsuit from the surrounding neighborhoods who appeared ready to declare that the noise levels were excessive. The PNYA was already defending itself against an anti-noise lawsuit at their New Jersey airport The airplanes used in passenger transportation at that time were all propeller driven.

Laymon's noise measuring setup was located at the edge of Idlewild airport about 1.5 miles from start of takeoff roll. He established a radio link

with the control tower and received for each flight the type of aircraft, its gross weight on takeoff, and the airline operating it. Also with a camera, he determined the height of the aircraft as it passed overhead.

In 1957 BBN's work with the Port of New York Authority greatly expanded. The PNYA had received a request from Pan American Airways to begin international flight operations out of Idlewild Airport using a Boeing 707 jet propelled aircraft. This was the first-ever commercial passenger aircraft using jet engines instead of propellers. The PNYA had heard rumors that the 707 was very noisy even though Boeing claimed that the noise levels produced by 707 flyovers were no greater than those produced by flyovers of the largest propeller driven aircraft. Their

statement was based on measurements with a standard sound level meter using the "C" scale.

I was invited to attend a special meeting art the headquarters of the Port of New York Authority in New York City in November 1956. The meeting was chaired by the head of PNYA, Austin Tobin, and also in attendance were the Port's director of aviation, John Wiley, and others. I was asked if BBN would take on a project to determine the facts about the 707 noise, and if it was noisier than Boeing claimed, what should be done about it.

In response, I stated that BBN had just employed one of the best experimental psychologists in the country, Karl Kryter. Also I pointed out that a noise measuring team headed by Laymon Miller was already making measurements for the PNYA of flyover noise at Idlewildd. I said that if we got

the project, I would be in charge and the procedure would be as follows: Miller would measure the noise of the 707 wherever that would take place and he would continue to measure the noise created by the largest propeller aircraft around Idlewild to be used as a basis for comparison. Kryter, using test listeners, would compare, subjectively, the measured jet noise with the measured propeller noise and if the 707 noise was excessive he would determine how much the jet noise would have to be reduced until the two sounded equally annoying. The PNYA accepted this proposal.

SLIDE: TOBIN, WILEY AND BERANEK

In January 1957 BBN, with Laymon in charge, made noise measurements of the fully loaded 707

aircraft at Boeing's Seattle airport at distances of 1 to 3 miles from start of takeoff roll. This slide shows me with Austin Tobin and John Wiley making measurements and recordings at one of the distances. These measurements and recordings were taken back to Cambridge for Kryter to use in his subjective annoyance studies.

The results of Kryter's comparisons were amazing. Measured with a standard sound level meter, the 707 jet noise would have to be reduced 15 decibels to make it no more annoying than the propeller-plane noise. This is an enormous amount. The PNYA informed Boeing that they would have to reduce the 707 noise by this amount if Pan American were to be given permission to operate out of Idlewild airport. In response, Boing designed and added heavy mufflers to the four engines on the 707. The noise of the modified

707 was measured in April 1958 in Seattle and it was still too high, by about 6 decibels.

Fortunately, the PNYA had just learned from the French manufacturers of the jet-propelled Caravelle aircraft that the noise over a neighborhood surrounding an airport could be significantly reduced if an airplane's takeoff procedure was modified. The take-off procedure required the airplane to climb with full power up to an altitude of 1,200 ft, then at that altitude, to cut back the power to the minimum required for level flight over the neighborhood.

[SLIDE: MILLER AND BERANEK IN PARIS]

To learn whether this procedure was truly effective, Miller and Beranek went to Paris in March 1957 to measure the noise levels produced

by the Caravelle over neighborhoods around the Paris Orly airport. The results when this takeoff procedure was followed were positive. A second set of measurements to verify this procedure was conducted by Miller and Bob Hoover at an airport outside London involving a British de Havilland Comet 4 jet propelled aircraft. Again, the results were positive.

When Boeing tried this takeoff procedure with the 707, the level measured by BBN was still too high by about 3 decibels. Boeing said that they could not possibly add any weight to the mufflers that were now on the 707. The PNYA then told Boeing and Pan American Airlines that when the 707 reached 1200 ft it would immediately have to turn away from straight ahead so as to further reduce the noise over the closest neighborhood. This demand angered both Boeing and Pan American.

They claimed the procedure might be unsafe. They tried to get the FAA to overturn this requirement, but to no avail because Idlewild is an airport privately and not Federally owned. But, Pan American subsequently found that this turn-away procedure was safe.

On October 28, 1958, the first 707 aircraft flight took place, with full passenger occupancy, between Idlewild in New York and Heathrow Airport in London. There were no neighborhood complaints.

One of Laymon's most challenging activities, again for the Port of New York Authority, took place in 1963. The town of Hempstead bordering Idlewild airport demanded in a lawsuit that either the aircraft noise levels over the community be drastically reduced or the airport should be closed

down. Laymon made hundreds of measurements of the noise from airplanes operating over Hempstead. He also measured other noises that the neighborhood had already accepted. He prepared over 100 exhibits. The case in the Federal District Court took place from February to March of 1965. Laymon was the principle witness for the PNYA and he was on the witness stand for seven days. The City lost its case.

Laymon and I worked together on another aviation case in the period from 1955 to 1965. Passenger helicopter service was proposed to be set up between the airports surrounding New York City and the middle of the city. The helicopter that was the most promising for this service was manufactured by the Piasecki Aircraft Corporation outside of Philadelphia. It was a military twin-rotor helicopter that would have to

be modified for transporting passengers. BBN's assignment was to reduce the interior noise levels.

The levels in the passenger compartment were so high that it was impossible for two persons to understand each other even when shouting with one person's mouth within a few inches of the other person's ears. To decide what had to be done to reduce the noise it was necessary to make measurements in flight.

[SLIDE: READY TO FLY AT PIASECKI]

Preparations for a flight in that vehicle at that time were frightening. We were told that we would have to wear parachutes. We were taken into a room where the parachutes were laid out on a table and we were asked to inspect them to make sure they were safe to wear. We knew nothing

about parachutes but one of the pilots helped us. We were told that if a rotor failed, the helicopter would fall straight down, not glide as would a winged aircraft. Our only hope for survival would be to throw ourselves against the entry door, thus opening it and hope we would fall free and be able to open our parachutes. We took our chances and we made measurements of the interior noise and determined where acoustical materials should be deployed. In the end, we drastically reduced the noise levels and made the helicopter suitable for passenger transport.

[SLIDE: LAYMON MILLER, *PRINCIPAL CONSULTANT,* AT BBN, WITH LEO (SEPTEMBER 1979)]

Laymon was one of BBN's most respected consultants. In 1960 he was given the title

"Principal Consultant", which was the highest rank any employee could receive at BBN. This came with a six month paid leave of absence every four years. He communicated exceptionally well with clients and we tended to refer our most difficult noise control projects to him. In Laymon's own summary, he was involved with noise control in ventilating systems, noise control for manufacturing plants, protection of communities from outside noise sources, quieting of products, and reduction of vibrations where sensitive equipment was involved.

[SLIDE: LUCY AND LAYMON]

Most precious to me have been my personal relations with Laymon and his wife Lucy. We communicated often even in his final year. It was a great privilege to have worked with him on so

many important acoustical projects. I know that his contributions (as he carefully assembled them in a publication for the NCAC) will serve as treasured references for generations of acoustical consultants in the years ahead.

Thank You

Slides and text prepared and presented by Bill Cavanaugh

Reminiscences on Laymon Miller's Remarkable 27 Year Consulting Career at BBN

Invited paper 1pAAb3.

William J. Cavanaugh – Cavanaugh Tocci Associates, Inc.
wcavanaugh@cavtocci.com

169th Meeting of the Acoustical Society of America
Pittsburgh, PA
May 18, 2015

"The purpose of the Society is to increase and diffuse the knowledge of acoustics and promote it's practical applications."

-ASA Bylaws

Laymon's Timeline Before BBN

- *1938*. BS Math and Physics, Texas College of Mines and Metallurgy (now UTEP: University of Texas at El Paso)

- *1939*. MS Physics, University of Texas at Austin
  Thesis subject on an experiment in radioactivity similar to earlier work by Hans Geiger. Invited to present his results at a meeting of the Texas Chapter of the Academy of Science

- *October 1941* (two months before Pearl Harbor). Recruited by Professor Ted Hunt as new director of Harvard's Top Secret Underwater Sound Lab (HUSL), charged with improving the US Navy's submarine detection capabilities. Other distinguished Physicists would later join HUSL, including Dr. C.P. Boner

- *August 1945* (end of WWII). The torpedo half of HUSL moved to Penn State and became the Ordinance Research Lab (ORL) where Laymon became head of the Acoustics section

Laymon's Timeline At BBN

- *Summer 1953.* Laymon attends Dr. Beranek's first summer program on noise and vibration control at MIT
- *April 1954*. Laymon receives a letter from Dr. Beranek inviting him and Lucy to Cambridge to consider working at BBN
- *September 1, 1954.* Laymon becomes BBN employee #014
- Immediately became involved in pioneering work on quieting jet engine testing cells, cooling towers, and other equipment for the burgeoning air conditioning industry, building noise and vibration problems, etc.
- The rest is history, beautifully documented by Laymon in *An NCAC Anthology in Noise and Vibration* (2013)

Laymon at 16 Elliott Street, Cambridge (1954)

A very happy and highly-chargeable employee!

While Laymon Was At BBN (1954-1981)

"While at BBN, I was…"

- US delegate to a Paris meeting on Airport Noise Problems held by the Organization for European Economic Cooperation (1959)
- Member of the ASA Technical Committee on Noise, TCN (1958-1961)
- Member of the NASA Research Advisory Committee on the feasibility of a US supersonic commercial jet (1960-1961)
- BBN representative at a special investigating committee of the US House of Representatives on "Noise and Its Effect on Man and Machine" (Washington DC, August 23-25, 1960)

While Laymon Was At BBN (1954-1981)

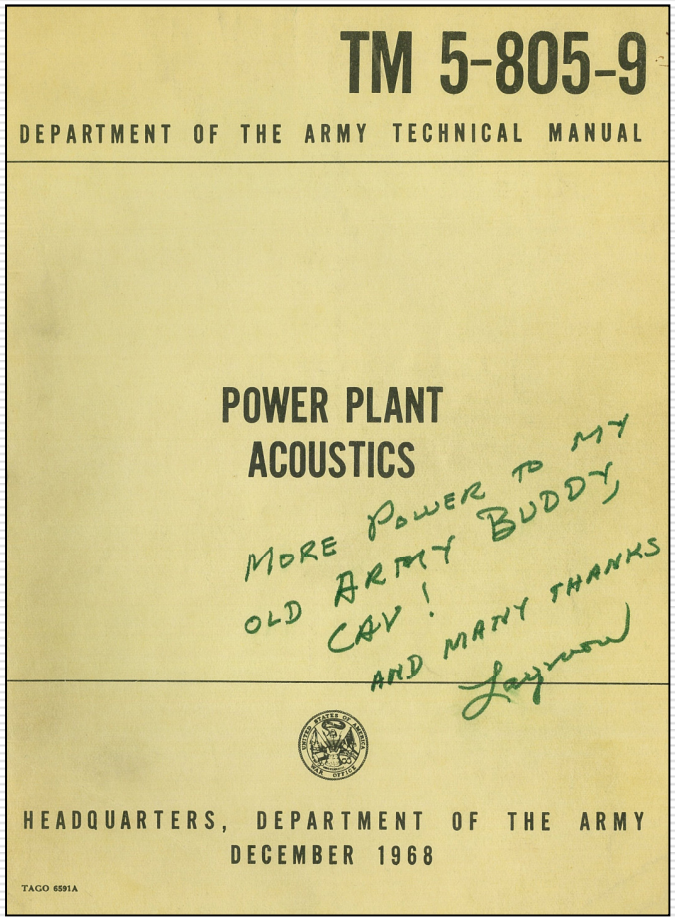
"While at BBN, I was…" [continued]

- Technical Editor for ASA's *Noise Control* magazine (1960-1961)
- Chairman, ad-hoc Committee on Noise for the National Academy of Engineering (1968-1970)
- Contributing Editor for *Sound and Vibration* magazine
- Continuing member of Sigma Xi (for many years)
- Member (then Fellow, Emeritus Fellow) of the Acoustical Society of America since 1943.
- Member INCE USA (1977, Board-Certified 1993)
- Named *First Principal Consultant* (1960)

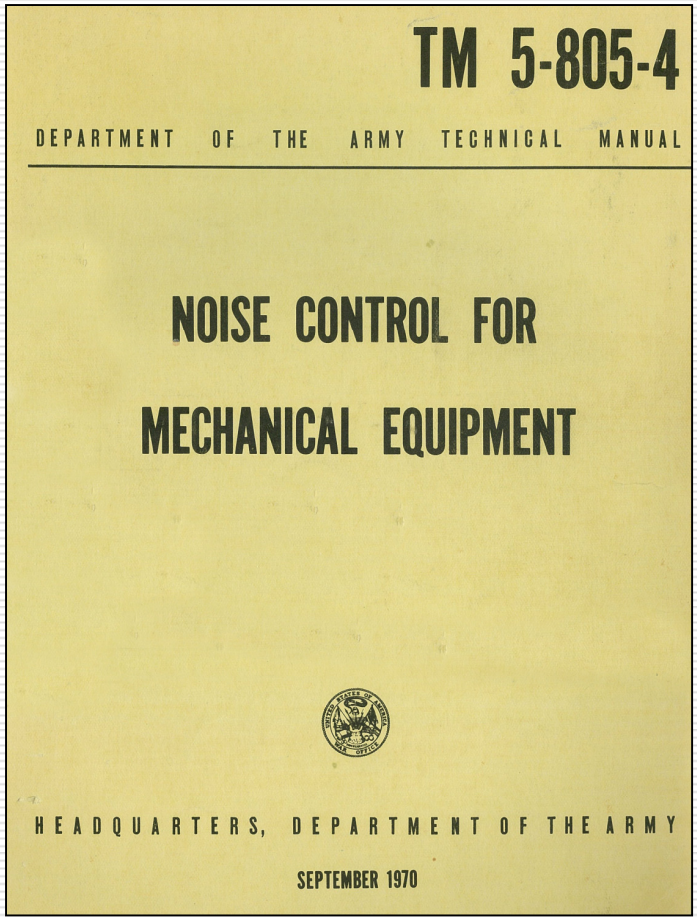
A Few Words on BBN Projects of Note

- *The Noise of Cooling Towers*. Baltimore Aircoil Engineering Manual (1962). Received award for exceptional merit in engineering, technical, and product literature
- Laymon's "traveling university" courses in noise control engineering (1960-present). Since 1981 taught by Hoover and Keith

US Army Corps of Engineers Technical Manuals



Power Plant Acoustics,
Department of the Army Technical Manual.
TM5-805-9 (1968)



Noise Control for Mechanical Equipment,
Department of the Army Technical Manual.
TM5-805-4 (1970)

Closing Thoughts

-"I am sitting in my office at home. In front of me is a model of the Caravelle twin-engine commercial jet. The model was given to us by Sud Aviation of France."

- and I'm still awaiting the final proofs from NCAC of my book. This might make a good picture for the cover… [quote added by Bill Cavanaugh]

Slide 1

Reminiscences on Laymon Miller's Remarkable 27 Year Consulting Career at BBN….and it was a remarkable one indeed!

Laymon and I both joined the BBN consulting staff in 1954, He on Sept 1st and I on Feb 1st. But that's where the similarities in our individual experience levels in acoustics ended. My only experience comprised of HS and college level physics courses with very short segments on sound. However I had taken two introductory courses in Architectural Acoustics in the 1949-50 academic year taught by Physics Prof Richard Bolt during my studies at the MIT School of Architecture. Graduate student Robert Newman served as Prof Bolt's teaching assistant.

(After WWII Bob had come to MIT intending to study toward a PhD in Physics with a concentration in architectural acoustics but Dick Bolt convinced him that getting a MArch would be a preferred step if he intended to focus professionally on architectural acoustics. Bob was such a gifted teacher that the Architecture Department offered Bob an Assistant Professorship and with his growing responsibilities in the new Bolt Beranek and Newman partnership to undertake private consultation and research that was evolving initially at MIT in 1948.)

Laymon on the other hand, came to BBN with an impressive record and wealth of experience in acoustics.

Slide 2 Laymon's Timeline before BBN (~ 17yrs)

An abbreviated timeline from Laymon's undergraduate studies in Math and Physics at TCMM in El Paso to graduate studies at the distinguished Physics Dept. at Univ. of Texas in Austin and how the onset of the US entry into WWII changed his professional life inextricably toward acoustics.

* 1938, BS in Physics and Math, age 20

*1939, MS in Physics, age 21

* Oct 1941 2 months prior to Pearl Harbor, recruited to Harvard's Top Secret Underwater Sound Lab.

* August 1945- July 1954 Ordinance Research Lab at Penn State Univ.

Slide 3, Laymon's Timeline at BBN (1954 -1981)

Laymon's 27 years at BBN greatly expanded and diversified his already significant wealth of knowledge in acoustics and its applications in buildings, concert venues, workplaces, and dwellings, recreational facilities, in transportation vehicles and systems and in the communities where people live. What's more Laymon, loved to teach others, fellow consultants, clients, colleagues at professional society meetings. I don't think anyone I know, except possibly his longtime friend and mentor Leo Beranek himself, who epitomizes the purpose of the

Acoustical Society of America….*to increase and diffuse knowledge of acoustics and to promote its practical applications* than Laymon Miller.

Here's a few points on the essence of Laymon's coming to and working for 27 years at BBN

* Summer 1953, attends Beranek's 1st Summer Course in noise and vibration control.

* April 1954, Beranek's letter offering position at BBN

* September 1, 1954 becomes BBN employee #014

* Immediately becomes involved in diverse and challenging noise and vibration control assignments Sof all types. Highly respected by colleagues and clients alike.

* Documented in Laymon's *An NCAC Anthology in Noise and Vibration. (2013)*

Slide 4, Laymon at 16 Elliott Street, Cambridge (circa 1954)

Slides 5 and 6

While Laymon Was at BBN (1954-1981) in his own words!

Slide 7

A Few Words on Laymon's BBN projects of note

+ "The Noise of Cooling Towers". Baltimore Aircoil Company's Engineering Manual (1962). *Received award for exceptional merit in engineering, technical and product literature!*

+ Laymon's "traveling university" courses (1960-present).

Since 1981, taught annually by Laymon's colleagues Bob Hoover and Reggie Keith then in BBN's Houston Texas office with Laymon giving occasional guest lectures. (more on this later by Reggie in hin paper)

Slide 8

US Department of the Army Technical Manuals:

+ TM 5-805- 9, Power Plant Acoustics (1968) Published earlier in 1960 as US Army Corps of Engineers Technical Report

+ TM 5-805-4. Noise Control for Mechanical Equipment (1970)

Slide 9-

Closing thoughts on an extraordinarily gifted acoustical consultant who made the world a better and "quieter" place!

Slides prepared and presented by Eric Wood

In Honor of Laymon N. Miller

Gentleman Friend Colleague and Mentor

About 1955

Joined Bolt Beranek and Newman in 1954

Elected BBN's first Principal Consultant in 1964

100^{+} bound technical reports for a wide range of clients, publications, and oral presentations

about 2000 noise and vibration projects where he provided practical engineering solutions

27 years later he retired in 1981

HONORS AND PROFESSIONAL SOCIETIES

Board Certified Member: Institute of Noise Control Engineering

Fellow: Acoustical Society of America

Honorary Member: National Council of Acoustical Consultants

Paul Boner Award: National Council of Acoustical Consultants

Outstanding Educator: Institute of Noise Control Engineering

First Principal Consultant: Bolt Beranek and Newman

In Honor of Laymon N. Miller

EDITORIAL ACTIVITIES

Contributing Editor to the *NCAC Newsletter*

Technical Editor at *NOISE Control Magazine*

Contributing Editor to *Sound and Vibration Magazine*

In Honor of Laymon N. Miller

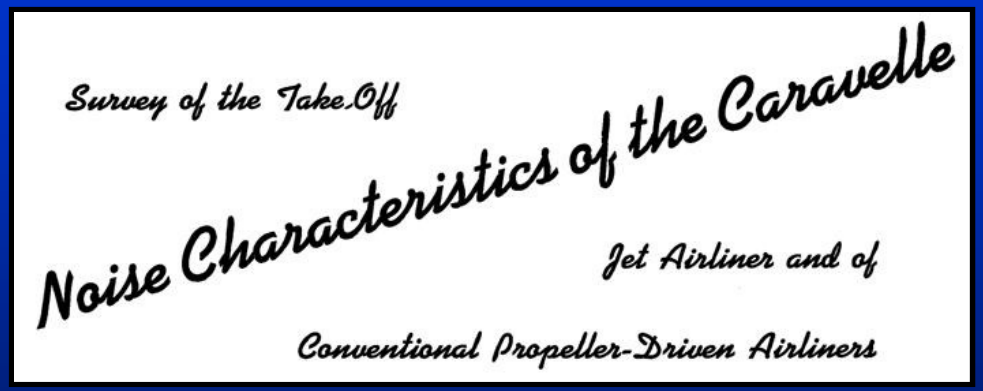
ADVISORY POSITIONS

Member of the NASA Research Advisory Committee on Aircraft Operating Problems 1960 to 1961

Chairperson of the Committee on Noise of the National Academy of Engineering 1968 to 1970

In Honor of Laymon N. Miller

Laymon with the Sud Aviation Caravelle
First Commercial Jet into NYC Airports
26 – 27 October 1958



In Honor of Laymon N. Miller

Laymon Spent Four Hours Flying Onboard Air Force One Responding to Concerns about Noise from President Lyndon Johnson

In Honor of Laymon N. Miller

Laymon's Contributions to Industrial and Community Noise Evaluation and Control

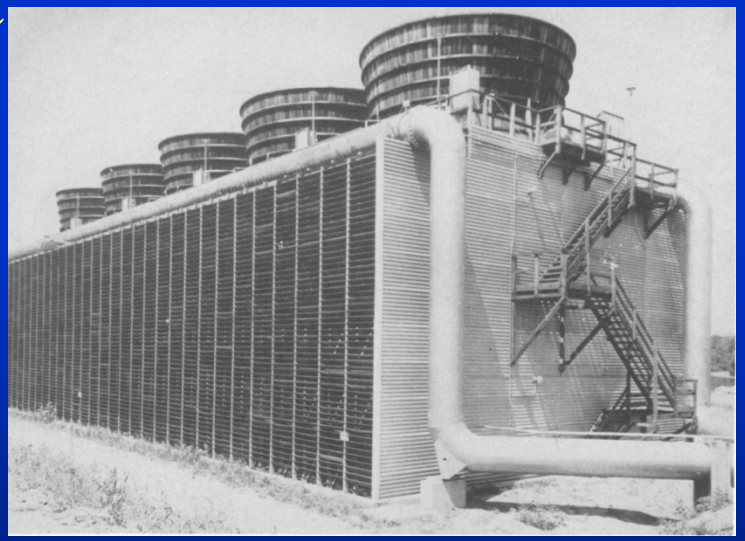
published engineering design manuals

In Honor of Laymon N. Miller

The Noise of Cooling Towers

Baltimore Aircoil Engineering Manual 1962

Awarded Exceptional Merit in Engineering, Technical, and Product Literature.

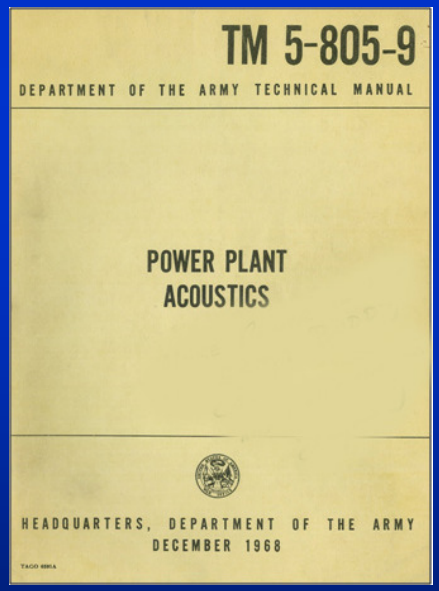


In Honor of Laymon N. Miller

Power Plant Acoustics

Army Technical Manual

TM5-805-9, 1968



In Honor of Laymon N. Miller

Noise Control for Mechanical Equipment

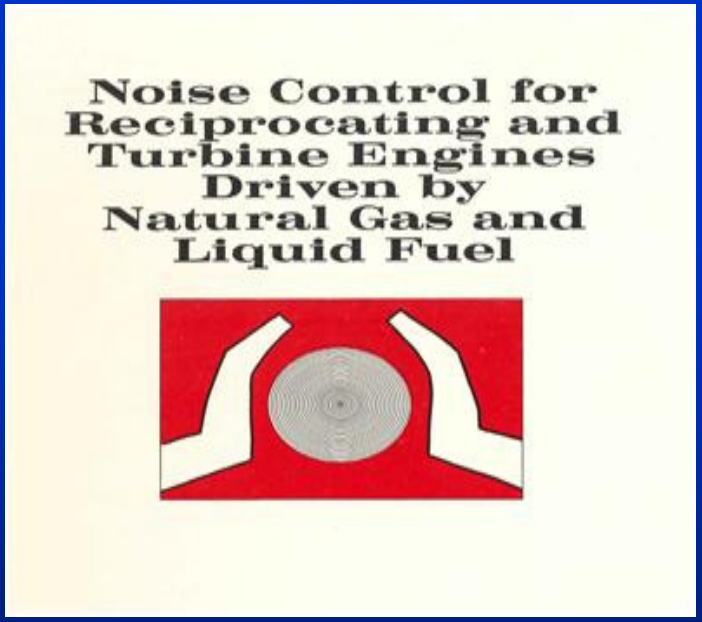
Army Technical Manual

TM5-80 5-4, 1970

In Honor of Laymon N. Miller

Noise Control for Reciprocating and Turbine Engines Driven by Natural Gas and Liquid Fuel

American Gas Association
Manual No. S20069, 1969

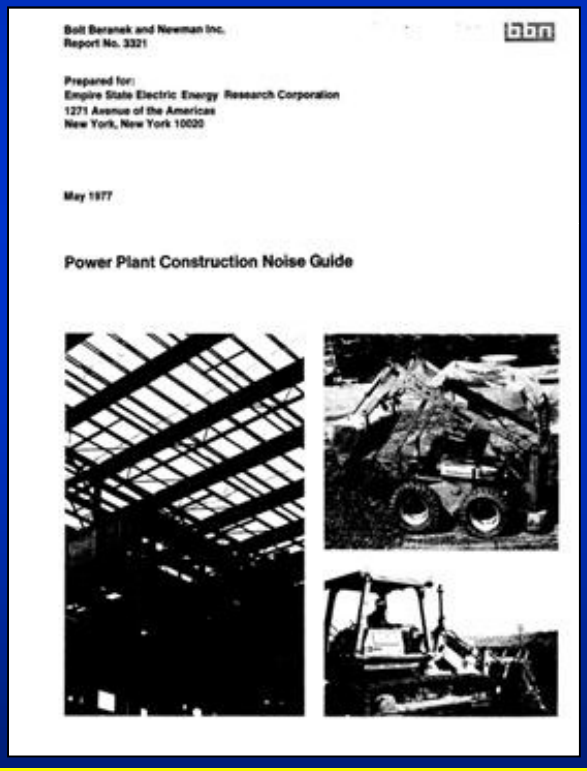


In Honor of Laymon N. Miller

Power Plant Construction Noise Guide

Empire State Electric Energy Research Corporation

New York 1977

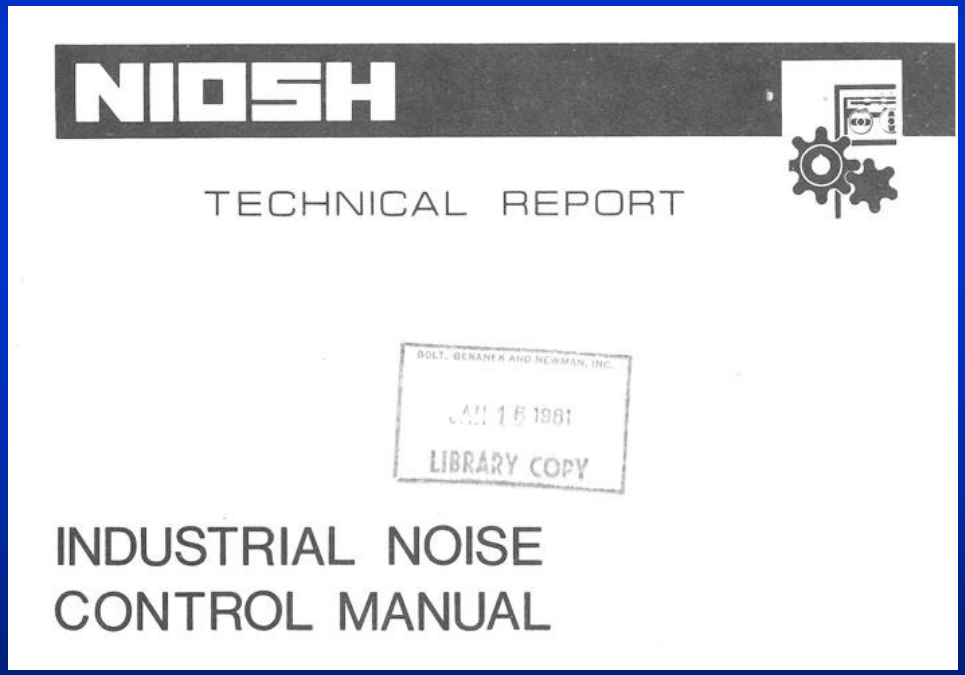


In Honor of Laymon N. Miller

Industrial Noise Control Manual

U.S. Department of Health, Education, and Welfare

1978

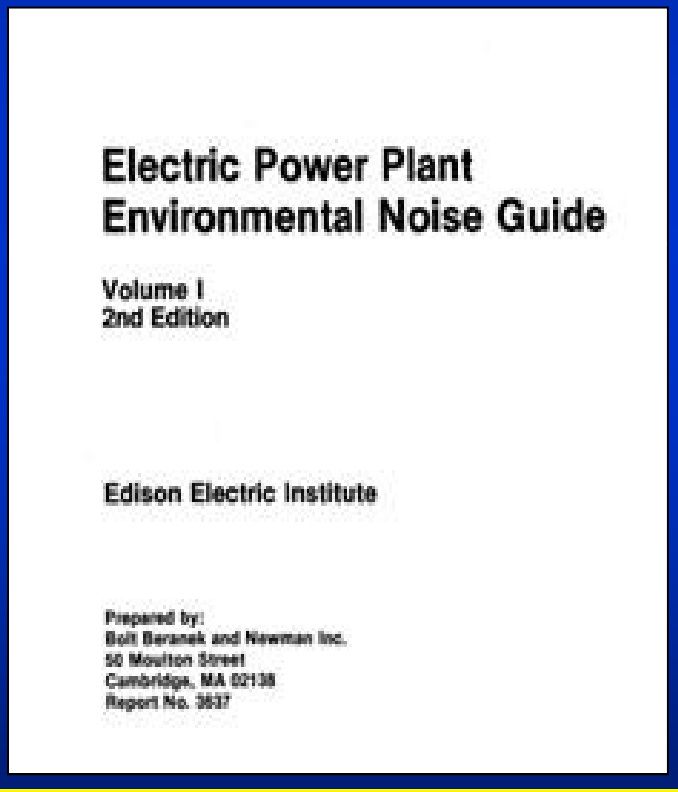


In Honor of Laymon N. Miller

Electric Power Plant Environmental Noise Guide: Vol. 1 and 2

Edison Electric Institute

Washington, D.C. 1978

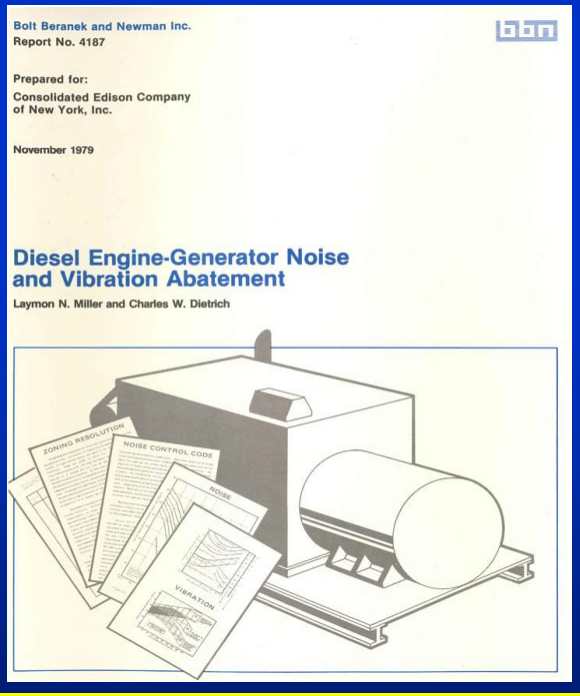


In Honor of Laymon N. Miller

Diesel Engine-Generator Noise and Vibration Abatement

Consolidated Edison Company of NY

New York 1979



In Honor of Laymon N. Miller

Laymon as a Mentor
His Advice to Consultants

Express your recommendations in ordinary language, not scientific or technical gobble-de-gook.

Write clearly and unambiguously, with adequate explanation and description (in words, figures, charts, drawings, illustrations, etc.). The client relies more on what you write than what you say.

Answer the questions that befuddle the problem.

Laymon as a Mentor
His Advice to Consultants

Consulting includes teaching: Teach the client enough about the "what", "why", and "how" of the acoustic decision or reasoning, so that the client can make informed decisions when the consultant is not present

Avoid giving snap judgments at the site or at first impulse. With time to think, a better solution may develop.

Maintain strict confidentiality of the client's interests and proprietary information.

Laymon as a Mentor
His Advice to Consultants

Laymon reminds us that:

The Quality of a Job Well-done will be remembered long after the Price is Forgotten.

Laymon While Away from His Office

Most presentations today focus on Laymon's many technical contributions to our profession

There is another important aspect shown in the following family photographs

Osawa Island, Ontario

40 acres 180 miles North of Toronto

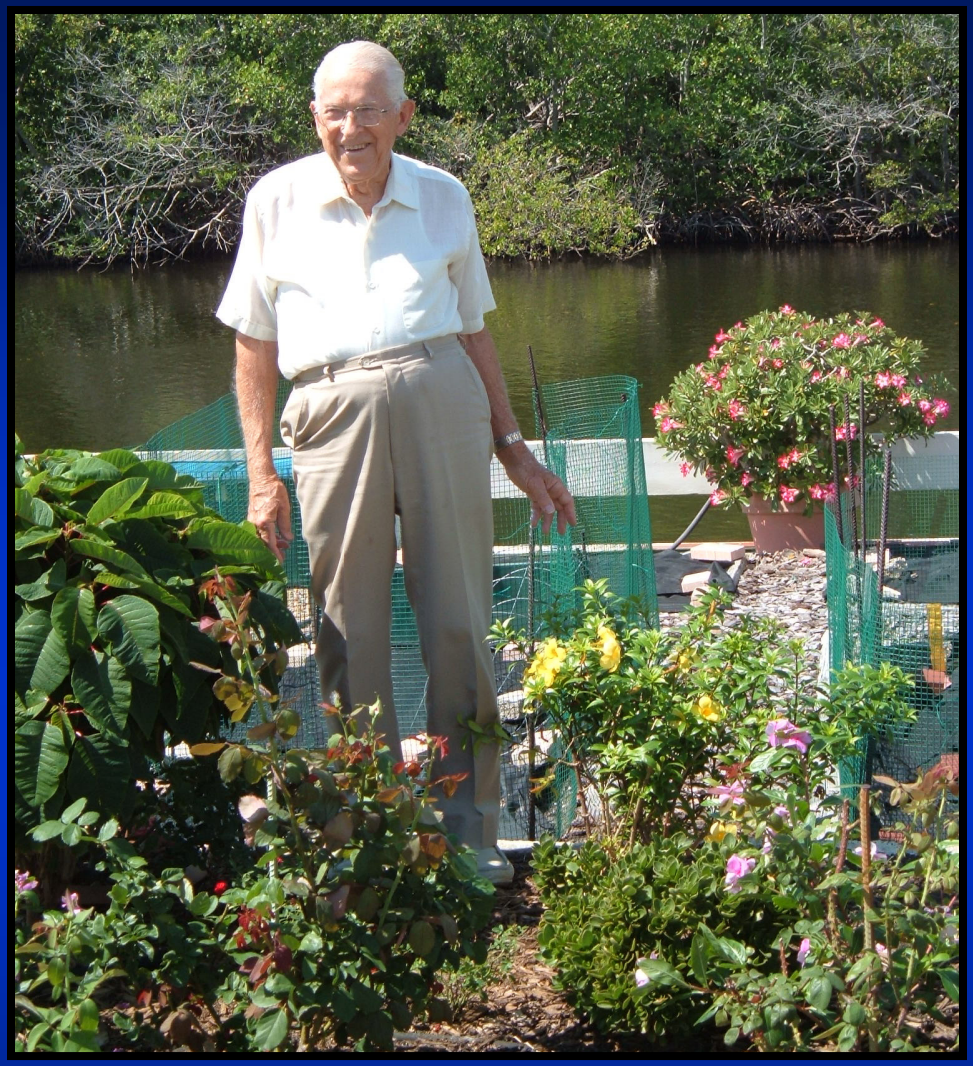
Six Generations of Family Gatherings

camping, boating, swimming, fishing

From Great Great Grandfather 107 Years Ago

“A Small Peaceful Place of Beauty”

In Honor of Laymon N. Miller



Laymon in his garden

In Honor of Laymon N. Miller

Laymon and Lucy 71st Anniversary Oct 2013

In Honor of Laymon N. Miller

90th Birthday Party 2008

In Honor of Laymon N. Miller

Son Bob, granddaughter Lindsay, great grandson Gabe, and daughter LucyLee with Laymon 2007

In Honor of Laymon N. Miller

Son Art and daughters-in-law Nancy and Dana with Laymon and Lucy

In Honor of Laymon N. Miller

Family gathering up north on the dock

In Honor of Laymon N. Miller

Laymon with a smile, truly a gentleman, waves to family, friends, and colleagues here today

In Honor of Laymon N. Miller

Slides submitted by Reggie Keith

Presented by Neil Shade

Text by Laymon Miller from 2003

Followed by text prepared by Reggie in 2008

FOREWORD by LAYMON MILLER (2003)

For me, noise control started a long time ago -- how about 1941-1945? That's when we were developing the acoustic homing torpedo for the U.S. Navy. At the Harvard Underwater Sound Lab (HUSL), we had to reduce our own torpedo's "self-noise" so that it could better hear the target signal. At the end of World War II, that kind of work continued when the ordnance part of HUSL was moved to Penn State, where I was in the Ordnance Research Lab until 1954. Bob Hoover joined our Penn State group in 1947, and we have been working together one way or another ever since that time. In 1954, I went to Bolt Beranek & Newman, Acoustical Consultants in Cambridge MA, and Bob joined me there just two years later. Then, in 1974, Reggie Keith joined BBN, and in 1978, Bob and Reggie formed their own acoustical consulting firm in Houston. So, these Lecture Notes represent the accumulation of work, study, and experiences by we three plus many others at BBN and H&K over many, many years.

Actually, the first of our Lecture Courses started in 1969, one year before OSHA. I had been given a six-months' sabbatical by BBN, and the lecture idea was suggested as a sabbatical project by my good friend and BBN associate, Bill Cavanaugh. At that time, we were getting lots of questions from our clients about how could

they learn some of these basic questions and answers to noise problems. One time I was an after-dinner speaker at an Engineering Society's meeting, and I was asked to tell them everything that I knew about acoustics in 45 minutes. So, in the midst of this timely interest, it seemed appropriate to consider a series of cross-country lectures on Noise Control (where I could talk longer than 45 minutes). This experiment began with a one-day course on "Noise in Manufacturing Plants" (etc.) and a two-day course on "Noise and Vibration Control for Buildings" (HVAC, etc.). My wife, Lucy, and I bought an Airstream Trailer and we spent 16 weeks circling the "lower 48" of the United States, giving these two courses in six cities: Seattle, San Francisco, Denver, Houston, Charlotte NC, and Washington DC. Lucy handled registration, hotel contacts and the slide projector, while I did the talking. In the following years, the courses were well attended, and we increased the length of each course a day at a time. When they had separately grown to three- and four-day courses, it became obvious that there was much overlapping, and many people were attending both courses; so we merged them into the five-day format that continues to this day. During that period, we had even introduced a one-day course on the "Management of Noise" for people concerned about OSHA regulations and needs. Each year, we scheduled at least one series on the east coast, one

on the west coast, and one in a central city of the U.S., and approximately every three years we offered our courses in Montreal, Toronto and Vancouver.

For the five-day course, the Lecture Notes were completely re-written and copyrighted, and they have been updated whenever there appeared to be new material to be included. I have often been asked if this material has become outdated. The fundamentals of acoustics are still the same and do not become outdated. New materials and methods and techniques can change and that keeps us on our toes. As I review the current set of Lecture Notes, I find much of my original work but I also see changes: new examples and technical additions, and many editorial and publishing improvements.

I retired from BBN at the end of 1981, but, with their blessing, continued to give the courses as a retirement activity. In 1988, I invited Bob Hoover to be a Guest Lecturer on subjects of his expertise. There followed a five-year period in which we transferred the course over to Hoover & Keith one day at a time. Then, they invited me to be a Guest Lecturer at "their course" for the next three years or so. Our happy relationship continues. An outgrowth of these nationally advertised courses, has been the tailoring of specific variations that have been given to many

architectural, engineering, industrial, and manufacturing groups both in the U.S. and Canada.

In my 27 years at Bolt Beranek & Newman, I had many wide-ranging jobs that provided a wonderful background and opportunity for me to learn and experience many types of noise and vibration problems and situations. In my early years, there was a shortage of noise data for many of the common noise sources, so I took a sound level meter and an octave band analyzer almost every time I traveled. I measured the noise of subways and trains, airplanes, autos and trucks, highways, street noise and community noise -- day and night. I measured fans, motors, pumps, compressors, refrigeration machines, and lots of cooling towers. A diffuser manufacturer let me make a whole series of measurements on his diffusers for all kinds of air flow conditions, and the Caterpillar Company let me make noise measurements on a group of their diesel engines. I measured power equipment in factories: punch presses, screw machines, wood-working machines. Much of this work was done on my own "in the pursuit of knowledge"; fortunately, some of it was paid for by our clients. I had three particularly generous clients who supported extensive noise measurements and studies of the noise-making parameters of some major kinds of equipment; those clients were: the U.S. Army

Corps of Engineers, the American Gas As- sociation, and Baltimore Aircoil Company, and those jobs led to useful engineering manuals, and some of the data (or updates of the data) are included in the tables in these Lecture Notes. When I joined BBN in 1954, Leo Beranek and Clay Allen were developing equations for the estimating of fan noise. Others in ASHRAE have since pursued the study of noise of most of the components in complete HVAC systems, and a few BBNers have contributed technical know-how on noise control of ventilation systems and their components. Bob Hoover and I have worked on the noise of ventilation systems in hundreds of buildings (including several very quiet music halls and auditoriums), both at the design stage and in retro-fixes. Noise measurements for power plant equipment have been conducted by BBN personnel for the Edison Electric Institute, and the noise of construction equipment has been measured for ESEERCO (Empire State Electric Energy Research Corporation, New York State), and most of that data are included here. At H&K, Bob Hoover and Reggie Keith and their staff have done extensive work on noise control with petroleum refining companies and electric power generating stations, as well as with many other acoustical engineering and architectural situations.

Several members of BBN worked for the Port of New York

Authority when commercial jet travel was just beginning, back in 1957-58. They (PNYA) imposed noise restrictions on the new jet aircraft, so that they would not exceed the takeoff noise of the earlier large four-engine propeller-driven aircraft. As a result, Leo Beranek and I went to Orly Airport outside Paris to measure the first Caravelle jet aircraft, and Bob Hoover and I went to the De Havilland field outside London to measure an early model of the Comet IV. A short time later, Leo and I were in the BBN group that measured one of the first Boeing 707s just before delivery to Pan Am Airways for trans-Atlantic operation; and still later, Bob Hoover and I measured the noise of the Boeing 727. The point is: There has been a long history of data collection, and much of that material is summarized in these Lecture Notes. Yes, some of those noise sources have changed over the years; some have gotten quieter and some have gotten noisier, but the noise-making mechanisms are still present, and we believe that the data given here will offer a good dependable base for current problems or for pursuing additional work. Perhaps you, the reader, will have an opportunity to extend that work.

Solutions to noise problems have ranged all the way from ordinary common-sense answers to some rather complex and innovative designs. For me, acoustics has been a challenging and

rewarding experience. I hope others can say the same. I want to add my thanks to all who have contributed to the content of these courses and to the many past, present, and future course attendees who have provided the incentive and interest to keep this material alive and vital to the still-emerging field of acoustics.

Especially, I thank my friends and associates from Bolt Beranek & Newman for their assistance and support, and Bob Hoover and Reggie Keith for their continuance of these Lecture Courses in Noise and Vibration Control.

Laymon N. Miller
January 2003

Recollections on the Laymon Miller Course by Reggie Keith

I first attended Laymon's course in 1977. And although I had a master's degree with a high concentration of acoustics courses and several years of consulting experience at BBN, this course has proven to be the most valuable of my 30+ years of acoustical education and consulting experience.

Laymon introduced revolutionary elements in his course, such as:

- Realistic (and calibrated) audio demonstrations. Laymon's equipment was somewhat primitive by today's standards; a Nagra III reel to reel tape recorder, amplifier and several speakers. These audio demonstrations included sound level differences, octave band filtered samples, A-weighted samples and the effects of noise induced hearing loss; as well as audio samples of many of the equipment items discussed in the course notes. This may be more commonplace now with digital recordings and more sophisticated sound reproduction systems, however 30 years ago it was unheard of (no pun intended).

- Many samples of noise control products (along with the manufacture's literature), together with pictures and explanations of their use in actual installations. This allowed the course participant to see and hold these items; and as such they became more than just model numbers or data sheets; they became real.

- Multiple discussions of actual noise and vibration control projects (with many pictures and illustrations) to edify and illuminate the basic principals of noise and vibration control. These, together with the audio demonstrations and manufacture's samples; seemed to transport student from the classroom to the actual installation.

- And finally the clarity, practicality, organization and comprehensiveness of his course notes represents a very delicate balance between lecture material for a single course and a valuable future reference document for any practitioner in the field of noise and vibration control, no matter what their level of involvement.

While the above elements are necessary for any great teaching experience; they alone are not sufficient. This has to be preceded with the knowledge and drive to create these elements, the ability to locate and obtain suitable teaching environments and inform students of the opportunity; as well as skill to communicate the course material to students with diverse interests and goals. Mr. Laymon N. Miller demonstrated that he has excelled in these qualities (i.e. knowledge, drive, ability and communication).

Was Laymon N. Miller a first class consultant that changed into a great instructor with time, or a great educator that simply started out as a first class consultant? I believe this question is rhetorical; he is with out a doubt both and the order does not matter.

Laymon N. Miller created, produced and taught a seminal course in noise and vibration control for over 30 years in many different venues and settings. He not only did this, he had the ability to make it memorable to all who attended.

Slides prepared and presented by Bennett Brooks

Laymon Miller

An Exemplary Acoustical Consultant

Bennett M. Brooks, PE, FASA, INCE
Brooks Acoustics Corporation
Vernon, CT USA

18 May 2015 – Pittsburgh, PA

Abstract

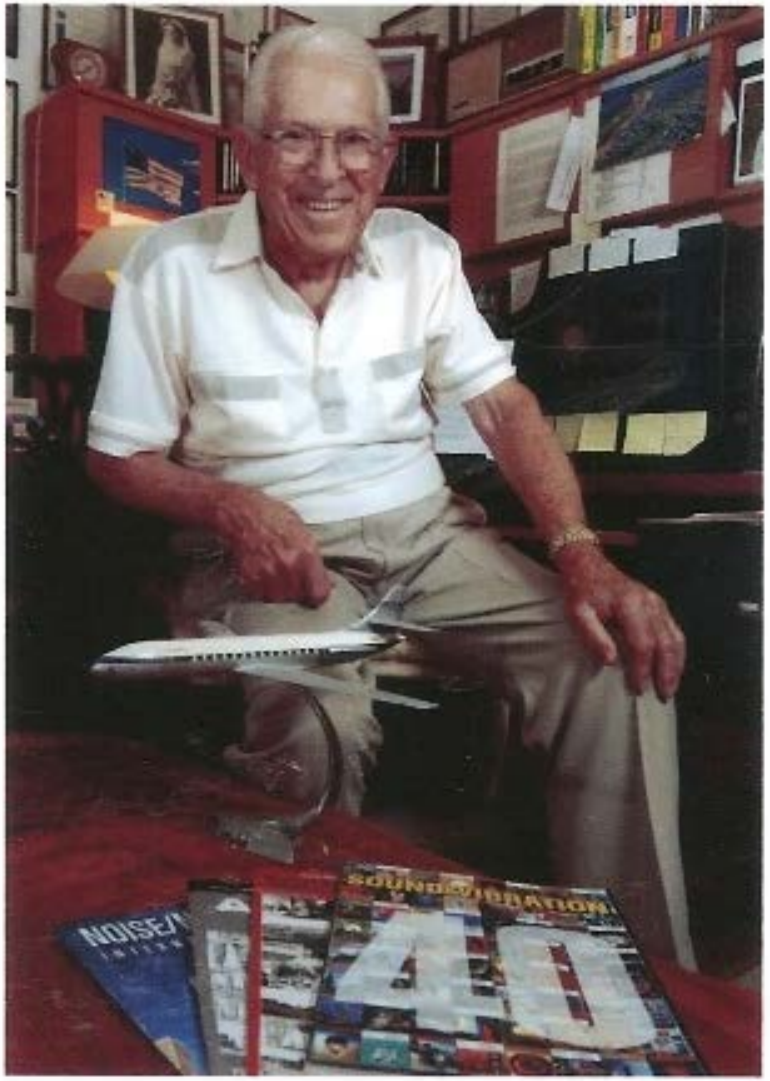
Laymon Miller was a "Consultant's consultant." He embodied a wonderful example of how to conduct oneself in the engineering consulting business, providing leadership in defining the functions and responsibilities of acoustical consultants. As a leader of our profession, Laymon was also a great friend to the National Council of Acoustical Consultants (NCAC). Former NCAC Newsletter Editor Bill Cavanaugh asked Laymon if he would serve as a guest editor for a continuing series tentatively titled "War stories … from the Consulting Veteran's files." Laymon answered the call, and this series continued for many years, capturing the "priceless gems" from which all of us, at all experience levels, can learn about the problems faced by consultants, and importantly about the solutions as applied in the field. Laymon was a talented and generous teacher, in print and in person, of those inside and outside of acoustical consulting. His experiences, related with insight and humor, have provided guidance to generations of those in general industry and to acoustical consulting practitioners alike. Laymon was elected an Honorary Member of NCAC in 1994, received the NCAC C. Paul Boner Award in 2007 and was honored with the Institute of Noise Control Engineering (INCE) Outstanding Educator Award for 2008.

Laymon Newsom Miller (1918 – 2013)

Laymon was a "consultant's consultant" !

- ***He embodied a wonderful example of how to conduct consulting projects, and***
- ***How to conduct oneself***
- ***Laymon was a true gentleman and a scholar!***

Laymon Miller – An exemplary acoustical consultant



Laymon N. Miller

Laymon's c.v. in brief (40 year career)

- ***1941 – PhD candidate U of Texas, Physics***
- ***1941 – 1945 Harvard Underwater Sound Lab (HUSL) Ted Hunt's SONAR lab***
- ***1945 – 1954 Penn State Ordinance Research Lab, Head of Acoustics Section***
- ***1954 – 1981 Consultant – Bolt Beranek & Newman (BBN Employee #14)***

Laymon Miller

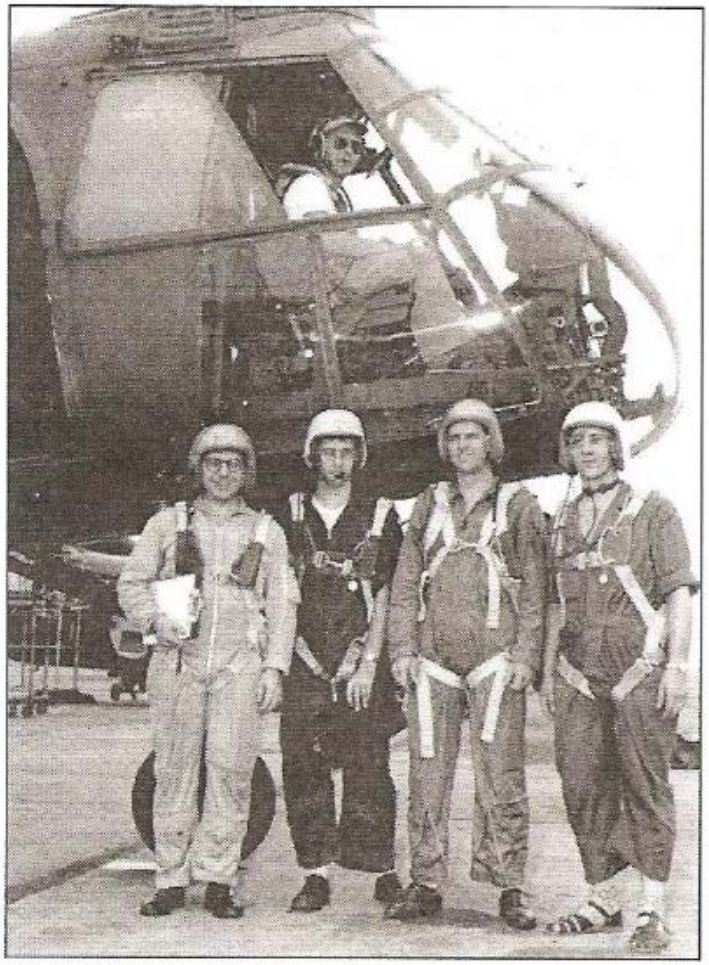
Acoustical Consultant at BBN for 27 years:

- ***About 2000 projects !***
- ***Noise and vibration control for HVAC***
- ***Noise control at manufacturing plants – OSHA***
- ***Community noise – mfg, hwy, airports, power***
- ***Noise and vib control – consumer products***
- ***Vib isolation design – for special instruments***

Laymon Miller – An exemplary acoustical consultant

BBN Principals with Laymon at 25th-year Celebration, May 15, 1979:
Bob Newman, Dick Bolt, Steve Levy, Sam Labate, Laymon Miller, and Leo Beranek.

Laymon Miller – An exemplary acoustical consultant



Noise and vibration measurements for a passenger cabin Noise reduction program on the Piasecki Military H-21 helicopter. Below from the left: Leo Beranek, Harry Sternfeld of Piasecki, Laymon Miller and another Piasecki engineer; above, the Piasecki pilot.

Laymon Miller – An exemplary acoustical consultant

Some of the Noise Measurement Equipment taken to Paris for the Caravelle study. This photo is offered primarily to show the bulky equipment used in those days (1957). The Ampex magnetic tape recorders worked only on 60-Hz AC (we called it 60-cycle in those days), and we had to take two sets of auto storage batteries and converters to produce power while we recorded out in the middle of the corn fields. In the photo, from the left: Laymon Miller, Leo Beranek, and the two Sud Aviation engineers who were our assistants while we were there.

Laymon Miller – An exemplary acoustical consultant

Figure 4. (Left to right) Laymon Miller, Leo Beranek and Weldon Clark of BBN in Seattle, Washington, July 18, 1958, with a Boeing 707 in background.

Laymon Miller – An exemplary acoustical consultant

Figure 5. Group in New York discussing the noise measurements of the British Comet 4 jet aircraft, August 15, 1958. Laymon Miller is seated at the far left. Beranek wears glasses. John Wiley and Austin Tobin are standing second and third from the left, respectively. The others are representatives from British Airways and Port of New York Authority.

Laymon Miller – An exemplary acoustical consultant

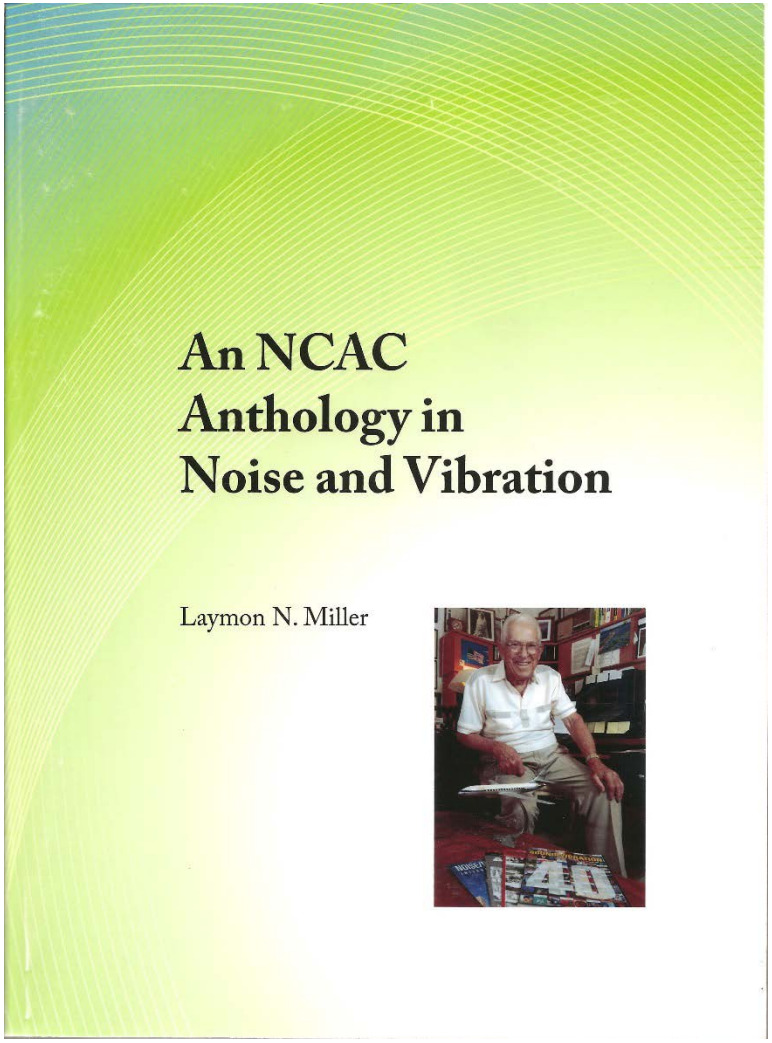
A Noise Measurement Trip to Paris in 1957. From the left, Laymon Miller and Leo Beranek are seen with engineers from Sud Aviation and the Orly Airport Administration. Noise measurements were carried out for the Port of New York Authority to determine if the French Caravelle, manufactured by Sud Aviation, could meet the take-off and landing noise requirements set by the Port Authority for their New York and New Jersey airports. Note the table full of "portable" noise measurement equipment required for the tests, which were made at Orly Airport, outside Paris. A brief description of this work was given in the NCAC Newsletter *for Fall 1997. A more technical discussion of the work was presented in papers co-authored by Leo and Laymon and appearing in the* Journal of the Acoustical Society of America *(Vol. 29, pgs 1169-1179, 1957) and in* Noise Control *magazine (Vol.3, pgs 42-47, November 1957 and Vol. 4, pgs 291-293, September 1958).*

Laymon Miller

Was a great friend of the National Council of Acoustical Consultants (NCAC)

- ***In 1995, then editor of the NCAC Newsletter, Bill Cavanaugh asked Laymon to serve as Guest Editor***
- ***Write a series called "War Stories – from the Consulting Veteran's files"***
- ***Laymon rose to the call***

Laymon Miller – An exemplary acoustical consultant



Laymon Miller – An exemplary acoustical consultant

Laymon's series called "War Stories – from the Consulting Veteran's files" continued for many years.

- ***As Cav states, the series captured the "Priceless Gems" from which we all can learn about the problems faced by consultants,***
- ***And more importantly, the solutions!***
- ***This series republished in the NCAC book.***

Laymon Miller – An exemplary acoustical consultant

Laymon was a talented and generous teacher:

- **In print and in person**
- **For those inside and outside of the acoustical consulting field**
- **His experiences were related with *insight* and *humor***
- **Provided guidance to *generations* of practitioners**

Laymon Miller – An exemplary acoustical consultant

Want to share with you some of Laymon's key insights.

But first:

- **A few "war stories"**
- **Hotel duct work (Bob Newman as related by Laymon)**
- **Apartment vertical exhaust ducts**
- ***Moral – rarely rely on others for the follow-up, do it yourself!***

The Functions and Responsibilities of Acoustical Consultants:

- ***Functions***
  - **Identify and evaluate the problem**
  - **Design a suitable noise control treatment**
  - **Evaluate the treatment**
  - **Communicate effectively**

The Functions and Responsibilities of Acoustical Consultants:

- ***Responsibilities***
  - **Judgement and experience**
  - **Subjective response, the human element**
  - **Design compromise**
  - **Education of the client**
  - **Responsibility vs. authority**
  - **Job limitations**
  - **Loyalty to the client**

The Functions of Acoustical Consultants:

- ***Identify and Evaluate the Problem***
  - **Consultants are requested to solve noise problems, some familiar, others unfamiliar.**
  - **On known problems the consultant applies accumulated knowledge to solve the problem in the most practical and cost effective means**

The Functions of Acoustical Consultants:

- ***Identify and Evaluate the Problem***
  - **For unknown problems, first define the nature of the problem and the characteristics of the source.**
  - **Calculate based on known conditions, or conduct a new experiment to derive suitable data.**

The Functions of Acoustical Consultants:

- ***Design a Suitable Noise Control Treatment***
  - **Know what is causing noise, how it is transmitted and how much reduction is required**
  - **Meet functional requirements**
  - **Practical and economical**
  - **Reviewed by all involved**

The Functions of Acoustical Consultants:

- ***Evaluate the Treatment***
  - **Follow-up work:**
  - **Review and check drawings**
  - **On-site assistance**
  - **Inspections to achieve desired installed conditions**
  - **Final evaluation of the completed system**

The Functions of Acoustical Consultants:

- ***Communicate Effectively***
  - **Consultant has little or no decision-making authority**
  - **Communication of ideas, designs and explanations must be clear and unambiguous**

The Responsibilities of Acoustical Consultants:

- ***Judgement and Experience***
  - **Understand and develop non-handbook solutions**
  - **Know appropriate solutions and materials**

The Responsibilities of Acoustical Consultants:

- ***Subjective Response, the Human Element***
  - **Tailor designs to meet the expected human response**
  - **With the most economical solution we may expect a few adverse reactions**

The Responsibilities of Acoustical Consultants:

- ***Education of the Client***
  - **A better informed client will make more successful decisions**
  - **Don’t overwhelm client with explanations, just the answer**

The Responsibilities of Acoustical Consultants:

- ***Responsibility vs. Authority***
  - **We live in a "no-man's land"**
  - **Perhaps our greatest dilemma**
  - **We advise, recommend, provide information**
  - **Do not usurp the decision-making power of the client**

The Responsibilities of Acoustical Consultants:

- ***Job limitations***
  - **8 hour job vs. 30-40 hour job**
  - **Advise client that we can *help* resolve the problem with an 8 hour job, but that may not yield a completely satisfactory solution**
  - **Client can weigh the costs vs. the risks**

The Responsibilities of Acoustical Consultants:

- ***Loyalty to the Client***
  - **All information kept confidential**
  - **Discuss project problems with the client so everyone knows the pros and cons of major decision**
  - **Be imaginative and ingenious**
  - **Maintain an open, honest and respectful association with client**

Laymon Miller – An exemplary acoustical consultant

"Air Force One", retired, was a special attraction on the grounds at Boeing's Museum of Flight, a few miles south of Seattle. This was the Air Force One that I worked on back in 1964; see NCAC Newsletter of Spring 1998. We were at the Boeing Museum in 2000 and had an opportunity to see it again.

Laymon Miller

Elected NCAC Honorary Member - 1994

Meeting in Cambridge, MA.

Laymon Miller

Honored with the NCAC C. Paul Boner Award - 2007

Meeting in New Orleans, LA.

Laymon Miller – An exemplary acoustical consultant

Relaxing at Arnaud's Restaurant after presentation of the Charles Paul Boner Award. (back row left to right): Laymon Miller, Charles Paul Boner, (front row left to right) Lucy Miller, Paul Ostergaard, and Bill Cavanaugh. Paul Ostergaard and Bill Cavanaugh are earlier honorees of the Charles Paul Boner Award.

Laymon Miller – An exemplary acoustical consultant

NCAC attendees celebrating Laymon Miller's award include (back row left to right): Dave Adams, Brian Marston, James Phillips, David Lubman, Bill Cavanaugh, Lucy Miller, Laymon Miller, Richard Boner, Ed Logsdon, Russ Berger, Dave Copeland, and Dave Marsh, (front row left to right) Richard Schrag, David Braslau, David Fagan, Tony Hoover, Stephanie Adams-Ball, and Bennett Brooks

The NCAC board and the entire NCAC membership applaud Laymon for his well-deserved recognition.

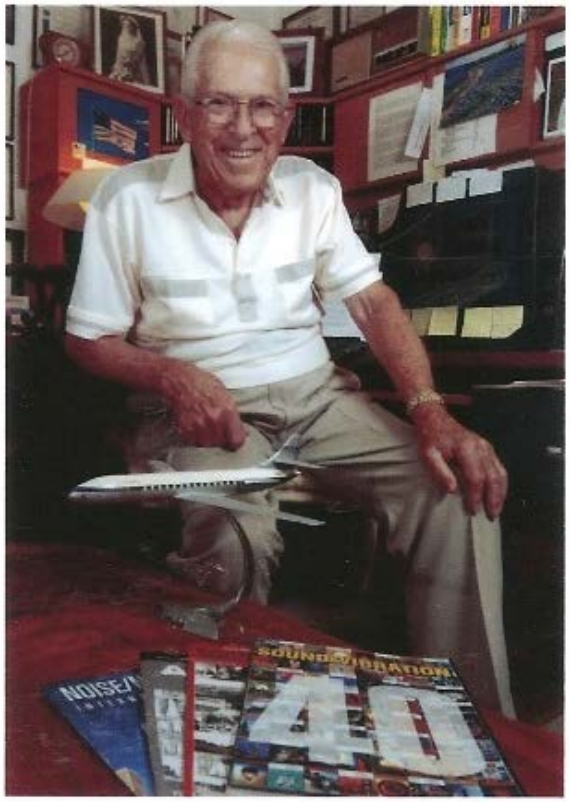
Laymon & Lucy Miller

Honored with the INCE Outstanding Educator Award - 2008

Meeting in Ottawa, Canada.

ENGINEERING BAC RESEARCH

Thank You, Laymon!!



Slides prepared and presented by Neil Shade

Architectural Acoustics, Noise, Structural Acoustics, and Vibration: Session in Honor of Laymon Miller

Experience as Editor of Laymon Miller's Book, *An NCAC Anthology in Noise and Vibration*

Neil Thompson Shade
Acoustical Design Collaborative, Ltd
Ruxton, MD
410.821.5930
nts@akustx.com

Peabody Institute of Johns Hopkins University
Baltimore, MD
neil.shade@peabody.jhu.edu

Acoustical Design
Collaborative Ltd

Architectural Acoustics, Noise, Structural Acoustics, and Vibration: Session in Honor of Laymon Miller

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Architectural Acoustics, Noise, Structural Acoustics, and Vibration: Session in Honor of Laymon Miller

Experience as Editor of Laymon Miller's Book, *An NCAC Anthology in Noise and Vibration*

Book title: *An NCAC Anthology in Noise and Vibration*

Subtitle: My Acoustics Toolbox: Filled with Decibels, Hertz and Memories and Occasional Bits of Boldness and Courage

Laymon dedicated his book to Leo Beranek

"My life has been a life of surprises" – Laymon Miller

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Architectural Acoustics, Noise, Structural Acoustics, and Vibration: Session in Honor of Laymon Miller

Experience as Editor of Laymon Miller's Book, *An NCAC Anthology in Noise and Vibration*

Book evolved from Laymon's talk at the 1995 National Council of Acoustical Consultants (NCAC) meeting

Invited by Bill Cavanaugh (NCAC Newsletter Editor)

- Laymon started writing articles for NCAC *Newsletter* in 1996

In 2008 Bill Cavanaugh suggested Laymon put together his writings in book format

- NCAC committee put together to determine how to publish the book

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Architectural Acoustics, Noise, Structural Acoustics, and Vibration: Session in Honor of Laymon Miller

Experience as Editor of Laymon Miller's Book, *An NCAC Anthology in Noise and Vibration*

Laymon wanted the book to be a useful compendium of his knowledge to pass on to others

Book provides

- Partial history of noise and vibration control consulting (1953 – 2012)
  - Tips on being a consultant
- "War stories" on consulting projects
- Fundamental information on noise and vibration control topics
- Personal ethics, philosophy, and musings (with humor)

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Experience as Editor of Laymon Miller's Book, *An NCAC Anthology in Noise and Vibration*

Book organization

Part 1 – Industry and trade magazine articles (19 articles)

Articles written 1957 - 2008

Time period 1942 - 2008

Part 2 – NCAC *Newsletter* articles (63 articles)

Articles written 1996 - 2012

Time period 1903 - 2012

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Part 1 – Industry and trade magazine articles

Heating Piping & Air Conditioning
Machine Design
NOISE Control
Sound & Vibration

Topics

Building noise and vibration control
Cooling tower noise control (BAC *Cooling Tower Noise Control Manual*)

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Book part 1 topics (continued)

- Equipment noise and vibration control
- Jet aircraft noise control (PANYNJ permission for jets to land at La Guardia Airport)

Articles related to BB&N consulting projects (1950s time period)

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Part 2 – NCAC *Newsletter* articles

Topics

- Expert witness testimony cases
- History of noise and vibration consulting
- History of Internet (Leo Beranek contribution)
- HVAC noise and vibration control design
- Tributes to colleagues and friends

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Book part 2 topics (continued)

- Project "war stories" (presenting technical knowledge with humorous outcomes)
- Tips on consulting (professional ethics, client relations, report preparation, expense accounts)

Articles related to work at BB&N and Laymon's life musings

Book concludes with Laymon's autobiography

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Experience as Editor of Laymon Miller's Book, *An NCAC Anthology in Noise and Vibration*

Process – beginnings to publication

Laymon provided camera copy of book contents

- Organized as he wanted the articles to appear

Secured rights from publishers for Part 1 articles

- Thanks to Jackie Williams of NCAC

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Architectural Acoustics, Noise, Structural Acoustics, and Vibration: Session in Honor of Laymon Miller

Experience as Editor of Laymon Miller's Book, *An NCAC Anthology in Noise and Vibration*

Process – beginnings to publication (continued)

Conference calls with Laymon and NCAC book committee

- Laymon was open to any and all suggestions for his book
- Involved regrouping some articles to fit topic organization

All 1996 – 2001 NCAC articles were missing electronic files

- Required retyping from NCAC Newsletters
- Thanks to my wife Victoria Vestrich and daughter Colette

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Architectural Acoustics, Noise, Structural Acoustics, and Vibration: Session in Honor of Laymon Miller

Experience as Editor of Laymon Miller's Book, *An NCAC Anthology in Noise and Vibration*

Process – beginnings to publication (continued)

Editing process

- Consistent grammar, punctuation, typos, format and layout
- References to other articles cross-checked

Desktop Publishing

- Deciding on book format size and cover design
- Converting nearly 70 MS Word files into Adobe InDesign
- Thanks to Tony Rosa (desktop publisher for NCAC *Newsletter*)

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Architectural Acoustics, Noise, Structural Acoustics, and Vibration: Session in Honor of Laymon Miller

Experience as Editor of Laymon Miller's Book, *An NCAC Anthology in Noise and Vibration*

Process – beginnings to publication (continued)

Editing and proofing final copy

- Went through 3 editing/revision cycles
- Errors in the file conversion and pagination
- Revisions in desktop publishing

Submission to book committee for review

- Suggestions for article format headings with date of publication
- Thanks to Bill Cavanaugh

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Architectural Acoustics, Noise, Structural Acoustics, and Vibration: Session in Honor of Laymon Miller

Experience as Editor of Laymon Miller's Book, *An NCAC Anthology in Noise and Vibration*

Process – beginnings to publication (continued)

The quest for a printer

- Books-on-demand printers contacted
- Sample copies reviewed for quality
- Thanks to Tony Rosa, Bill Cavanaugh and Kerrie Standlee

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Architectural Acoustics, Noise, Structural Acoustics, and Vibration: Session in Honor of Laymon Miller

Experience as Editor of Laymon Miller's Book, *An NCAC Anthology in Noise and Vibration*

What I learned as book editor

- Editing tough job to retain flavor of the author's intent
- Never underestimate problems with technology
- Respect the ideas of others – we are have the same objective

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Architectural Acoustics, Noise, Structural Acoustics, and Vibration: Session in Honor of Laymon Miller

Experience as Editor of Laymon Miller's Book, *An NCAC Anthology in Noise and Vibration*

What I learned as about Laymon editing his book

- Laymon's contributions to noise control engineering and BB&N
- Font of knowledge
- Willingness to share with others
- Respectful and appreciative towards others
- Proud of his humble beginnings
- The importance of hard work
- A loving family man
- Most important of all: that one can enjoy one's work and live life to the fullest

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Experience as Editor of Laymon Miller's Book, *An NCAC Anthology in Noise and Vibration*

Questions and Comments

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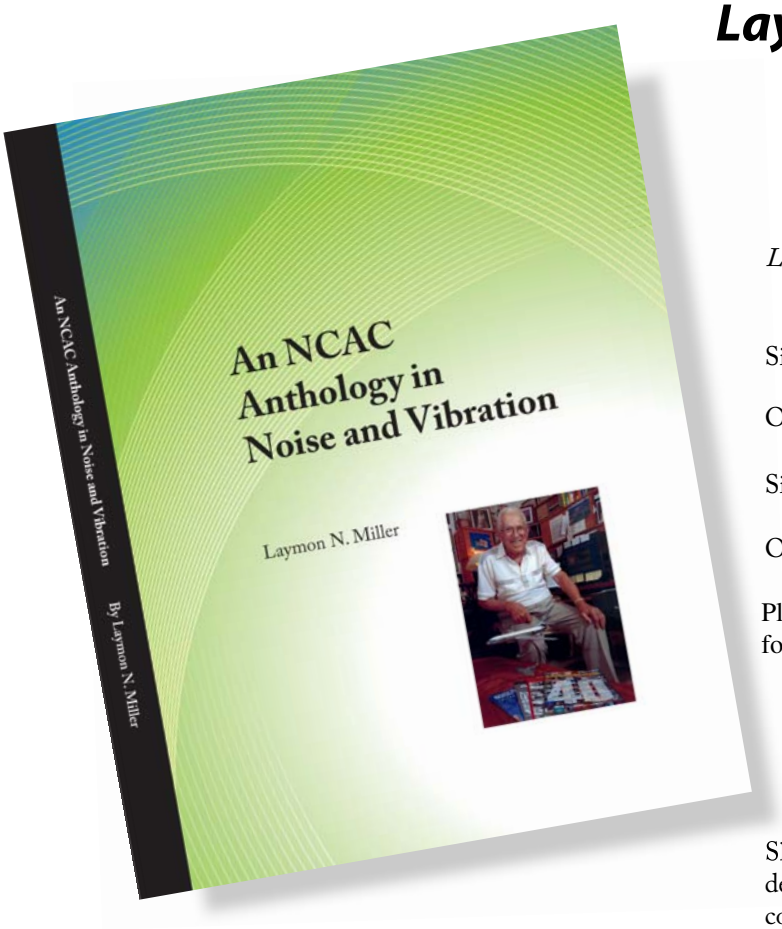
An NCAC Anthology in Noise and Vibration by Laymon Miller

Laymon Miller Book Order Form

An NCAC Anthology in Noise and Vibration



List price.....$44.95 per book

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Order of 5+ books, NCAC member ..... $35.95 per book

Single book, non-member..... $44.95

Order of 5+ books, non-member ..... $40.95 per book

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E-Mail: _____ Number of Books _____

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NATIONAL COUNCIL of ACOUSTICAL CONSULTANTS

9100 Purdue Road, Suite 200
Indianapolis, IN 46268
(317) 328-0642 • FAX (317) 328-4629
<www.ncac.com>
E-mail info@ncac.com

Session Presenters: Bennett, Bob, Eric, Neil, and Bill