THE HERITAGE SOCIETY OF PACIFIC GROVE

The Board and Batten

The Pacific Grove Historical Journal

WINTER 2024 - THE TECH ISSUE

Early Lighthouse Technology at Point Pinos

by
Jerry McCaffery





U.S. Navy Radar and Weather Facility

Pioneer in weather prediction technology

1952 - 1974

Digital Research Inc.

Pioneer in personal computing technology

1974 - 1991



About this issue of *The Board and Batten*

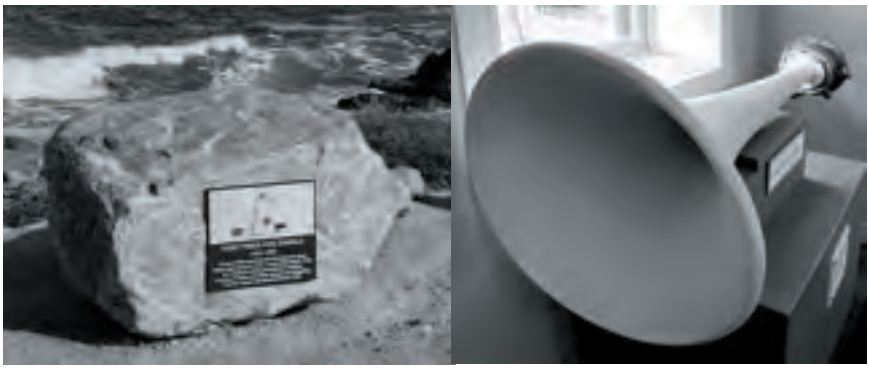
As a tribute to former docent Jerry McCafferty who passed away in 2023, this issue reprints material from his book about the early days of technology at Point Pinos Lighthouse. The next two stories reveal little-known local high-tech milestones of 50 and 60 years ago that have reshaped how the way the world lives, works, and plays.

- In 1964, the Navy established the communications division of the Fleet Numerical Weather Facility at Point Pinos. As the FNMOC, it continues today as a world-leading weather prediction center near Monterey Airport.
- In 1974, at his home in Pacific Grove, Gary Kildall demonstrated CP/M, the first commercially successful operating system for personal computers.

Not covered in this issue, but also tech related, in 1974, the first *Asilomar Microcomputer Workshop* (amw.org) invited key players in the field to present their work, much of which led to the digital world of today. The movers, shakers, nerds, and greybeards of the industry will meet again for the fiftieth time in April.

Foghorn Plaque Installed

A plaque installed at Point Pinos in late 2023 commemorates the generations of devices that have startled landlubbers while warning mariners away from the dangerous rocks.



The plaque is mounted on a rock in the Foghorn parking turnout. The Leslie SM 25 Super Tyfon, the last foghorn to deafen local residents, is on display in the Lighthouse Museum. Photos: David A. Laws

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605 Laurel Avenue, Pacific Grove, California 93950

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Early Lighthouse Technology at Point Pinos

From *LIGHTHOUSE* by Jerry McCaffery
Introduction by David A. Laws



Point Pinos Lighthouse in 1876 photographed by Eadweard Muybridge
Photograph courtesy U.S. Coast Guard Historian's office

Jerry McCaffery a Pacific Grove resident and lighthouse docent from 1995 until 2007, wrote and published the book *LIGHTHOUSE, Point Pinos, Pacific Grove, California* in 2001. After retiring from the Naval Postgraduate School as a professor of financial management and budgeting, Jerry and his wife Nancy moved to Green Bay, Wisconsin, where he passed away in March 2023.

As a contribution to this technology-related issue and a tribute to Jerry's dedication to preserving and presenting the history of early lighthouse technology and the challenges that keepers at Point Pinos faced in managing them, the following information on three key technology components (Fresnel lens, lamp, and eclipser) of the Point Pinos light is excerpted from pages 22 through 39 of *LIGHTHOUSE.*



Jerry McCaffrey c.2000
Photo: Barbara (Roo) Hornady

The Heritage Society thanks Nancy McCaffery for permission to reprint these excerpts that have been edited and reordered to some degree but, as far as possible, retain the author's original voice. Copies of the book are available for purchase at the gift shop and at Bookworks in Pacific Grove.



Front cover of LIGHTHOUSE

Introduction

Since 1855, when light first beamed out across the southern entrance to Monterey Bay, Point Pinos lighthouse has borne witness to a remarkable transformation in technology and engineering from hand-trimmed wicks of whale oil lamps to sophisticated automated systems.

One of the earliest known examples of a lighthouse for mariners was a towering structure off the coast of Egypt. Erected around 280 BC and standing over 300 feet tall, the Pharos of Alexandria is considered one of the Seven Wonders of the Ancient World. Its primary light source was an open flame fueled by wood.

As maritime trade routes expanded, so did the need for navigational aids. Early lighthouses in Europe often used open fires atop towers to warn of dangerous coastlines. The first recorded lighthouse in the Americas was the Boston Light, built on Little Brewster Island in Boston Harbor in 1716. The structure was a circular, tapered tower of rubblestone about 60 feet high. Multiple candle arrays that had to be replaced every few hours were protected from the elements by a simple wooden lantern room and glass enclosure.

Over objections from the U. S. Treasury that it was too expensive, mariners petitioned the government to adopt a lens invented in the 1820s by Augustin Fresnel in France that offered more visibility over greater distances. In 1851, Congress required that in "All new lighthouses… the Fresnel system shall be employed" and established a Lighthouse Board of military and civilian specialists to administer the nation's lighthouses.

Design of the Point Pinos Lighthouse began at this critical moment in the transition to the new illumination technology. The original lantern room layout intended to hold 12 lamps and reflectors was modified to accept the Fresnel lens.

The Fresnel Lens (from *LIGHTHOUSE* pages 22 to 27)

The case for the Fresnel lens was compelling. As a Fresnel lens both reflects and refracts, 85% of the light is projected out in a horizontal beam versus 15% from a reflector. The lens not only made an oil lamp appear four times brighter but also cheaper to operate than multiple reflectors and lamps.

The Lighthouse Board recorded the range of savings from the Fresnel system. In 1855, it reported 511 lighthouses with 5,110 lamps, an average of ten lamps per light. These lamps used an average of forty gallons of oil, or 204,400 gallons a year. The Board estimated that the new Fresnel system would require 148,150 gallons of oil, a savings of 56,250 gallons a year. Oil cost $2.25 a gallon; thus, the Fresnel system would save $126,562 a year. (Note: All prices quoted are in 1855 dollars. Multiply by ~30 for today's value)



The Point Pinos third order Fresnel lens. Photo: Dennis Tarmina

While more expensive to purchase initially, with proper care, a Fresnel lens will last indefinitely. The lamps and reflectors were not so durable. The silver backing on the reflectors would wear out, and they would go out of round, thus diminishing the focus and effectiveness of the light. As one lamp would replace 10 to 12 lamps, the savings on the purchase of oil would pay for the cost of the lens in less than four years.

Fresnel lenses came in different sizes, called "orders" (see the appendix, A Fresnel Lens Primer**),** ranging from first to sixth order for different purposes. Biggest were the landfall lights, those that the mariner sees when first approaching a country from overseas. These usually employed first or second order lenses like the one at Pigeon Point or even a super first order like the Highland light on Cape Cod, which is visible 45 miles and up to 75 miles in clear weather. Second in size are warning lights, usually with a third or fourth order lens, to announce a reef or shallow water.

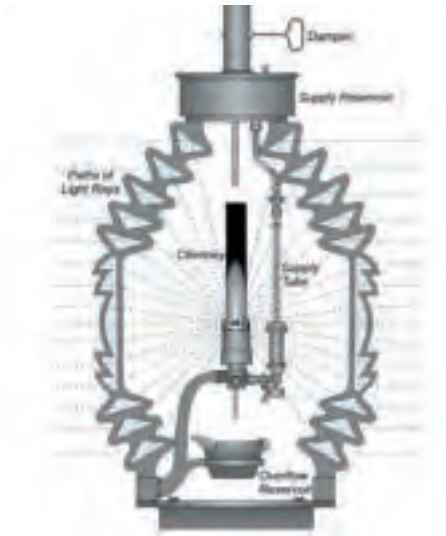
The first order lenses were huge. The lens at Point Sur weighed 4,330 pounds and stood 8 feet 10 inches tall with a diameter of 6 feet 3.5 inches and a weight of 9,570 pounds. These lenses cost up to $12,000 at the time First order lenses were also very bright. On a scale of relative brightness where a six order lens is rated a one, the third order lens was 3.85 brighter and the first order lens, 17.69 times brighter.

Manufactured in France by Henry-Lepaute on Rue St. Honore, Paris in 1853, the Point Pinos third order Fresnel lens stands 62 inches tall, weighs 1,985 pounds, and cost $3,810.



The Henry Lapaute, Paris manufacturer's label. Photo: David A. Laws

The Lamp (from pages 30 to 35)



After oil lamps replaced candles, lighthouses burned many different types of fuel over the years. Whale oil was used initially, but as demand proliferated, its price skyrocketed from 34 cents a gallon in the 1840s to $2.54 per gallon in the 1850s. The Lighthouse Board tested other fuels, including vegetable oils. At a cost of 89 cents a gallon, liquified lard oil was chosen in the late 1850s. This was replaced by kerosene in 1880 and pressurized kerosene from 1913 until electrification in 1919. Point Pinos burned about one gallon of kerosene per night.

A late 1800s-style oil lamp showing the re-direction of light rays through the Fresnel lens. From a drawing by Frank Perry.

The lamp was lit an hour before sunset and burned until an hour after sunrise. In December at Pacific Grove's latitude, this would have meant lighting the lamp at about 3:44 in the afternoon and extinguishing it at about 8:13 the next morning, about 16.5 hours. In June, the lamp would have been lit at 7:26 in the evening and burned until 6:37 the next morning, about 11 hours.



Brick house for oil storage built at Point Pinos in 1899. Photo: David A. Laws

Each morning, the lamp fuel tank would have to be filled. The keeper would draw a gallon of oil from an outside storage container, filter it, and carry it up two flights of stairs to the lamp room and then up a short ladder and through the hatch into the tower, for a total of about 120 steps.

Oil lanterns were sturdy, but they did have problems. These included fuel supply clogs, sooted chimneys, and insects fouling the wick. Changing sooted chimneys could be done quickly without putting out the main light; Emily Fish, keeper from 1893 to 1914, remarks on changing one in two minutes. The process took longer when the lamp had to be turned off to clear a fuel line or clean or trim the wick. Trimming the wick meant the keeper had to light an emergency light and shut the main light down, tap the wick a few times until the ashes fell off, and then relight it.

This sounds simple, but it was also painstaking work and could not be rushed. If turned up full force, the flame would be too hot for the cold glass chimney, so the procedure was a slow process of cracking the fuel valve, lighting the flame, bringing the chimney down a bit, gradually opening up the fuel valve, and slowly bringing down the chimney until the flame was at full height and the chimney was all the way down.

Clogs in the fuel line presented more complex problems than trimming the wick because the actual blockage had to be found. For example, the log

of Allen Luce, keeper from 1871 to 1893, records problems with oil clogs, once in 1889 and five times in 1891. In 1889, the float in the fuel reservoir stuck, and Luce had to go down into the basement and bring up the spare lamp, place it on the light table, and light it, a process lasting from 8:50 to 9:45 p.m. During this time, a small emergency lamp would have been lit.

In the morning, the lens had to be polished and prepared for the coming evening, and all the windowpanes around the lantern room had to be washed. This meant turning out the lamp, wrapping the lamp chimney in felt for protection, and carefully dusting, wiping, and polishing the lens with special cloths. Keepers wore linen aprons while working around the lens to prevent it from being scratched by buttons.



Two recent generations of lamp technology. From left: Halogen (1940 – 2021) LED (2021 on). Photos: Dennis Tarmina, David A. Laws

The Eclipser (from pages 36 to 39)

With the increase in the number of lighthouses along the coast and the increase in coastal traffic in the 1890s, it became necessary to give each light a distinctive characteristic so that mariners would know which lighthouse they were seeing. Some lighthouses, such as at Point Sur, rotated the lens to generate a flashing signal.

Before the advent of electricity or electric switching, a mechanical eclipser provided the signature at Point Pinos. The eclipser is a triangular shield of copper driven on a track around the light assembly by a mechanism of gears, pulleys, and weights that caused the beam, as seen from the ocean, to flash on and off. The weights totaled 58 pounds and would have to be raised every 4 hours with a hand crank. By varying the

size and timing of the eclipses, each lighthouse could have a distinctive flashing signature so two lights on opposite sides of a bay, say Point Pinos and Santa Cruz, could be given different signatures

The Point Pinos eclipser was installed in 1912. The log of keeper Emily Fish notes some teething problems with an eclipser that had to be assisted by hand every 30 seconds throughout the night. After several sleepless nights, a Mr. Miller arrived to solve the problem. As Miller never reappears, we assume that Emily learned to run the eclipser and to fix it herself when it broke.





The eclipser and clockwork mechanism demonstration unit at Point Pinos. Photos: Chris Patton

The eclipser began its use with the kerosene lantern, stayed during the installation of the pressurized version in 1913, was kept after the light was electrified in 1919, and remained in use until an automatic flasher was installed in 1940. The eclipser and a lantern were kept for backup until the early 1950's.

Appendix: A Fresnel Lens Primer

Fresnel lenses are optical devices used in lighthouses to project light over long distances. A Fresnel lens is characterized by its unique design, which allows it to be much thinner and lighter than conventional lenses of the same focal length. It consists of a series of concentric prisms, each with a specific angle and curvature. The lens is essentially "cut" into separate sections, or prisms, resembling a series of narrow rings. The prisms reflect and refract (bend) light, allowing it to be focused into a concentrated beam, making it more visible over long distances and in difficult weather conditions.

Fresnel lenses are categorized into different orders based on their size, complexity, and the brightness of light they produce. Lighthouse lenses are generally first, second, or third order, with first-order being the largest and most powerful. The order of a Fresnel lens is determined by the number and curvature of its individual lens panels —the higher the order, the more complex and powerful the lens.

First Order Fresnel Lenses are the largest and most powerful lenses used in lighthouses.

- They have a focal length of 920 mm, are up to 8 feet high, and can weigh 3,000 pounds
- First order lenses were typically used in large seacoast lights

Second Order Fresnel Lens are smaller than first-order lenses but still significant in size.

- Second order lenses have a focal length of 750 mm, are up to 7 feet high, and weigh over 3,500 pounds
- They were used in Great Lakes lighthouses, seacoasts, islands, and sounds.

Third Order Fresnel Lenses are smaller and lighter than both first and second order lenses.

- Third order lenses have a focal length of 500 mm, are up to 5 feet high, and weigh 2,000 pounds
- They were often used in shorter lighthouses and seacoast sounds, river entry, bays, and channels.

As technology has advanced, most lighthouses now use more modern and efficient lighting systems, but historic Fresnel lenses are still maintained and preserved in some locations, such as our beloved Point Pinos, for their historical and architectural significance.

Elevation Drawings of the lighthouse building from an 1854 schematic



U.S. Navy Radar and Weather Research Facility at Point Pinos

Pioneer in weather prediction technology

By David A. Laws



Weather by Computer.
Photo: Computer History Museum

Ancient Brahmin law decreed that a weather forecaster who predicted badly should have his tongue removed, cutting off the source of the poor weather report. This did nothing to improve the weather forecast, gave pause to would-be applicants for the job, and did little to advance the science. Methods have improved since, and the sanctions imposed for failure reduced to civilized grumbling. There may even come a day when the citizen's irritation with the weatherman is rare.

This tongue-in cheek prediction in *Weather by Computer*, a report published by pioneering supercomputer manufacturer Control Data Corporation (CDC) in 1963, has proven substantially true. We may still grumble that local weather forecasts are not perfect, but they exhibit a degree of accuracy unimaginable 60 years ago, and we can access them instantaneously on our smartphones. Research projects initiated by the Fleet Numerical Weather Facility (FNWF) at the computer center in Monterey and laboratory in Pacific Grove contributed significantly to this degree of convenience and precision.

Data collection, digital processing, and transmission techniques developed by FNWF engineers and scientists laid the foundations for modern weather forecasting technologies that today ensure that, in the colorful words of Navy veterans, "Today, a fish can't fart in the ocean without the Navy knowing about it in real-time."

The Naval Postgraduate School moves to Monterey

The U.S. Navy moved the Naval Postgraduate School (NPS) from Annapolis, MD, to a new campus on the former Hotel del Monte in Monterey in phases from 1948 to 1952. The Department of Mathematics purchased its first electronic automatic digital computer, a National Cash Register NCR 102A, in 1953. One of its early applications was the simulation of weather patterns.

NPS was selected for installation of Model #1, Serial #1 of the world's first commercially successful transistorized computer, the CDC 1604, designed by rock-star computer architect Seymour Cray. All prior machines employed unreliable, power-hungry vacuum tubes. Cray personally supervised the work in the converted lobby of the first floor of Spanagel Hall in 1960.



Installation of the CDC 1604 at NPS
Photo: Calhoun: The NPS Institutional Archive

"I was there when Cray sat at the 1604 console and, like a master pianist, ran through the test programs," said Edward Norton Ward, a mathematician and the first computer technician hired by Professor W. R. Church, Chairman of the Mathematics Department. "I watched and listened. When it's raining knowledge, you just hold out your hand." Ed is noted for writing a program that could properly display a three dimensional representation in only two dimensions. He lived in Pacific Grove and was known locally for his landscape paintings of the Monterey coastline. In a link to the next story, in the early 1970s, Ed shared an office at NPS with Gary Kildall, the founder of Digital Research, Inc.

According to Professor Douglas Williams, former Director of the NPS Computer Center, the CDC 1604 "was used by submitting machine language programs on paper tape. There was no operating system and no assemblers, compilers, or utilities. I obtained a Fortran compiler — folklore says it was written by Seymour Cray — and began teaching classes on its use to standing-room-only audiences of faculty and students." Despite these limitations, the 1604 boasted impressive computing power for the time, with 32,768 bits of 48-bit core memory and 100,000 computations per sec.

The Numerical Weather Problems Group

To develop weather forecasts serving strategic needs worldwide, especially at the ocean surface, in 1959 the Navy established a Numerical Weather Problems Group (Project NANWEP) in Suitland, MD under Cmdr. Paul M. Wolff. To take advantage of the powerful new addition to the NPS computing capability, the Navy assigned the project to Monterey. A tenant on the NPS grounds, NANWEP operated under the control of the Director of Naval Weather Services, Washington, DC. According to then Lt. j.g. Harry Nicholson, "NPS students would use the 1604 during the day, and we'd use it at night."

With a staff of 25 enlisted and civilian employees, by August 1960, NANWEP demonstrated the first machine-to-machine distribution of weather charts drawn automatically from digital data. As the *Monterey Peninsula Herald* reported, "the first surface weather map to be produced by a computer . . . it cuts the time for compiling hemispheric weather forecasts from hours to minutes. And is 40 percent more accurate than old hand methods."



Numerical printout of temperature at the sea surface and various depths. Image: Weather by Computer

Renamed Fleet Numerical Weather Facility (FNWF), with a mission to generate operational weather prediction products for the Navy, the project purchased its own computers in 1961. A second CDC 1604 was installed and programmed to process data for the production of daily weather prediction charts. Peripheral equipment included a CDC 160A for data transmission, ASR-33 teletype machines, Calcomp 565 drum plotters, and seven-track magnetic tape drives.

An important first for FNWF was a three-dimensional analysis and prediction of the atmosphere for the entire northern hemisphere, from the surface all the way up to the 35,000-foot level where the stratosphere begins.

In a speech to the *American Meteorological Society*, Wolff distinguished FNWF's work from other similar activities in the field: "Atmospheric and oceanographic analysis and prediction problems have been faced before — in the universities, in industry, in governmental agencies. To my knowledge, however, FNWF acts singularly in its treatment of the two fluids as a single, coupled system. Correct solutions to environmental problems demand this approach."

FNWF's role was also broader than other civilian and military agencies engaged in weather prediction. It involved not only gathering real-time data from more than 10,000 reporting sources and then processing the information to generate weather maps but also, by December 1960, routinely distributing the results to more than 100 operating Navy units worldwide.

The 1964 *NPS Annual Report* noted that FNWF "scored a first in high-speed RF transmission of weather data when a series of tests were conducted using SYNCOM Communication Satellites. Raw data and finished charts were transmitted error-free from Monterey to Hawaii and Guam at rates averaging better than 3,000 words per minute."



Navy personnel operate the computer console and tape drives in 1964. Photo: Calhoun: The NPS Institutional Archive.

As Wolff commented, "Unlike wines, environmental forecasts don't improve with age! To provide complete, real-time environmental support (our reason for existence), we must engage in a struggle against time itself."

To eliminate conflicts between the immediate demands of computer processing time for weather prediction and the teaching needs of the school, in 1964, FNWF built a dedicated computer center on the NPS campus.

FNWF Communications Division established in Pacific Grove

Collection, storage, and distribution of weather-related data required developing complex new broadcasting and data communications equipment and associated computer software tools for high-speed transmission of weather charts and data by radio and telephone landlines. To serve this aspect of its mission, FNWF established a separate Communications Division to design, fabricate, and test special-purpose electronic communications and interface devices to serve unique requirements for receiving and transmitting real-time weather data. Administration offices, workshops, and R&D laboratories of the division were located in a former Navy radar training facility on the Point Pinos Lighthouse Reservation at 1352 Lighthouse Avenue, Pacific Grove in 1964. The three-story, nearly 12,000 sq.ft. concrete bunker structure was considered "home" by FNWF personnel until the consolidation of operations near the airport in 1974.

When NPS acquired an IBM 360 Model 67 in 1967, the first CDC 1604 was transferred to FNWF and moved to Point Pinos, where it continued to serve for archival storage of weather data and other engineering purposes.

The Point Pinos Lighthouse Reservation

The FNWF building and its site have a long and interesting history. Ancestors of the Ohlone Costanoan Rumsen-speaking people lived on the Monterey Peninsula, including the oceanfront near Point Pinos, for thousands of years before Spanish explorer Sebastián Vizcaíno visited in 1602 and named the headland Punta de Los Pinos. There are at least eight known prehistoric archaeological sites located in the sandy dune area overlooking the entrance to Monterey Bay. Registered with the State's Native American Heritage Commission, it is considered sacred by descendants of the Indigenous people.

Under Mexican rule, the point was part of the 1833 Rancho Punta de Pinos land grant. After the United States seized control of California, Point Pinos began an association with federal and local government agencies that continues today. The US government surveyed the land in 1851 and took one half square mile on the end of the point as the site for the lighthouse. Thomas Larkin and David Jacks claimed ownership of the land, resulting in an argument that continued until the case was settled in 1880, with the government relinquishing its claim to all but about 27 acres as the Point Pinos Lighthouse Reservation. The Lighthouse Board, composed of senior naval officers and civilian experts, oversaw the building of the longest continually operating lighthouse on the Pacific Coast, which opened in 1855.



Historical points of interest on the Point Pinos Lighthouse Reservation lands.
Source: www.pointpinoslighthouse.org

The U.S. Coast Guard took control of the lighthouse in 1941. During the war years, the Coast Guard Beach Patrol occupied the reservation with barracks, stables, and dog kennels and erected a 40-foot camouflaged watchtower. In 1942, the U.S. Army 54th Coast Artillery Battery of African-American soldiers constructed sandbag revetments in the dunes and operated four 155-millimeter field guns. They bivouacked in tents on the site of the future FNWF headquarters.

New Navy building

The Navy erected the building in 1952 to accommodate a Naval Intercept Training Facility to teach pilots and air controllers the techniques of radar-controlled intercepts of enemy aircraft in the early years of the Cold War. The facility also provided aircraft tracking support to carriers operating off northern California and assisted distressed pilots in emergency landings at the Naval Air Facilities at Monterey and Moffett Field.

Eighteen-inch-thick concrete walls layered with three rows of rebar, subfloors carrying large cables to service radar and electronic equipment, and multiple underground vaults and trenches throughout the property support reports that it was intended to serve as a station of the Pacific



Contiguous Barrier (PCB). The PCB was an extension down the Pacific coast of the DEW (Direct Early Warning) Line, the continental air defense system across Alaska and Canada guarding against Soviet bombers carrying nuclear warheads. The Pacific Grove facility is one of the sole remaining habitable buildings from that era's coastal defense infrastructure.

Point Pinos Naval Air Intercept Training Facility and Naval personnel operating equipment. Photo: All Hands Naval Bulletin, March 1961



The government transferred the lighthouse and military reservation, except for this site, to the City of Pacific Grove in 2006.

Activation of the Environmental Data Network (NEDN)

To collect the vast number of observations required for analysis and to transmit the completed products to the Fleet, in 1965, the Navy upgraded a domestic Weather Service Computer Network to serve international sites in Guam and Spain and renamed it the Naval Environmental Data Network (NEDN). The nodes were connected by dedicated telephone circuits (called tie lines) operating at 2400 bps. FNWF acted as the master computer center and controller of NEDN.

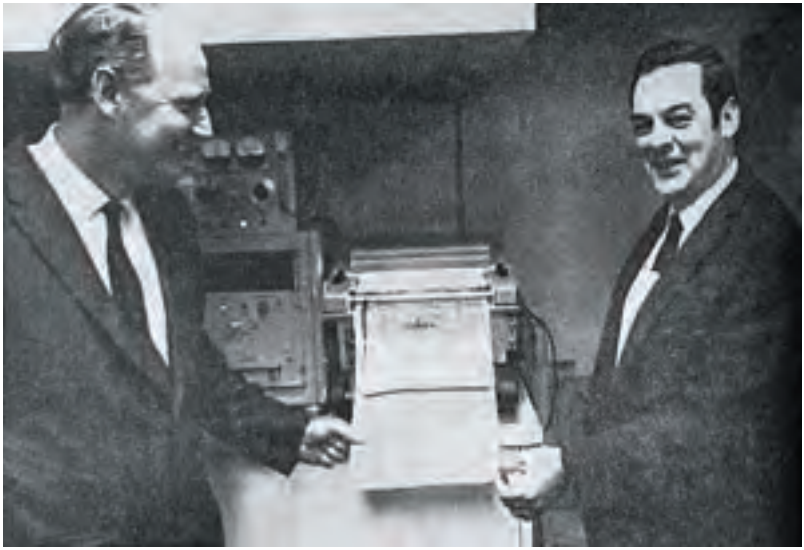
Oceanographic data were derived from a variety of military and civilian sources, including commercial fishing vessels and marine-oriented Scripps Radio station WWG in La Jolla. Using this data, FNWF performed hemispheric analyses and generated forecasts every twelve hours of the essential ocean-state parameters (temperature, wind strength, wave height, etc.) required for the support of the fleet. These reports were transmitted to nodes on the NEDN, where they were tailored locally for their specific regions and then sent to the operating forces via radioteletype and radio facsimile broadcasts.

In recognition of the increasing importance of FNWF's work to naval operations, the facility designation was upgraded to Fleet Numerical Weather Central (FNWC) in 1968.

New generations of computers and communications

FNWC continued as an early adopter of powerful new computers. A dual-processor version of CDC's ground breaking 6600 supercomputer, installed in 1967, offered a significant performance increase over the 1604. It employed 250,000 silicon transistors, ten times as many as the 1604.

Each new computer generation provided a dramatic reduction in the time to perform meteorological calculations, as well as significantly lowering the cost per calculation. Twenty cents per five million computations in 1967 represented a 15-times cost reduction over that of the 1604 in 1961.



E. R. Reins and E. L. Whitworth review the map transmitted by satellite.
Photo: Monterey Peninsula Herald

Accompanying this progress in computing power, similar advances in communications technology made the speed of distribution and breadth of access to fast-changing weather conditions an even more important contribution to the needs of the Navy's operating units. Led by principal engineer Ed Whitworth in 1970, technicians at the Point Pinos labs designed special electronic circuits that enabled the first pictures of current and predicted environmental conditions to be transmitted via the COMTACSAT-1 satellite to ships at sea.



The *Monterey Peninsula Herald* reported that "The USS Guadalcanal, on cruise in the Atlantic Ocean and USS Lexington, in port at Pensacola, Fla, received, as reported by personnel aboard the ships, weather maps far superior in quality to those relayed by conventional radio facsimile methods." Communication by satellite bypassed many of the slower links in the NEDN chain that delayed the transmission of vital information.

Satellite receiving antenna. Photo: Monterey Herald

FNWC Moves to its own facility in Monterey

With staff grown to 170 people, in 1974, FNWC began to consolidate its operations in Pacific Grove and the NPS campus onto a new site on Grace Hopper Avenue near Monterey Airport.

Known today as FNMOC, the Fleet Numerical Meteorology and Oceanography Center continues as a vital component of the Naval Meteorology and Oceanography Command, which provides worldwide meteorological and oceanographic data and analysis for the U. S. Navy and strategic allies of the United States. The FNMOC is highly respected, and its computing capability ranks as one of the most world's powerful in its field.

The NOAA Years

The Point Pinos facility served as a Naval Recruit Command center until 1994 when the property was transferred to the National Oceanic and Atmospheric Administration (NOAA) as a laboratory for the Pacific Environmental Group (PEG) to provide science-based data products in support of fisheries research and management. PEG had a long standing association with FNMOC to apply military data to civilian purposes. NOAA scientists used this information to develop data sets and environmental indices used to characterize ocean properties and processes occurring within fishery habitats.

Then known as the South West Fisheries Science Center (SWFSC), in 2007 the facility commissioned internationally renowned artist Ray Troll to design a mural to present the work of SWFSC to the public in a colorful but scientifically accurate manner. Comprising 32 six-by-eight-foot panels, the "Green Seas, Blue Seas" mural encircles all four walls of the building. Each panel recounts cultural, ecological, historical, and scientific information related to species and events endemic to Monterey Bay, and each wall represents a cycle of the Pacific Decadal Oscillation. As these natural variations have been repeated throughout history, the mural has no true beginning or end. In this sense, it has been described as the world's longest mural. The Museum of Natural History mounted online and physical exhibits, Cool Critters of the California Current in Words and Pictures, of Troll's original drawings.





The NOAA building before and after the Troll mural.

Photos
Above: Ray Troll
Right: David A. Laws

SWFSC vacated the building in 2014. In 2022, the federal government sold the building at auction to private bidders from the East Coast. The new owner's plans for the building are unknown. Members of the Center for Ocean Art, Science, and Technology (COAST), a group established to promote local ocean-related artistic and scientific interests, are urging the protection of the mural and the history of the building.

Gary Kildall and Digital Research Inc.

The Birth of the PC Operating System

By David A. Laws

Late one afternoon in the fall of 1974, computer programmer Gary Kildall and electronic engineer John Torode "retired for the evening to take on the simpler task of emptying a jug of not-so-good red wine … and speculating on the future of our new software tool".

By successfully booting a computer from a floppy disk drive, they had given birth to an operating system that, together with the microprocessor and the disk drive, would provide one of the three fundamental building blocks of the personal computer revolution. While they knew it was important, neither realized the extraordinary impact it would have on their lives and times.



Gary Kildall in 1988.
Photo: Copyright Tom O'Neal

Gary Arlen Kildall was born to a family of Scandinavian descent in Seattle, Washington, in 1942. His inventive skills flourished in repairing automobiles and having fun but suffered in scholastic pursuits. He qualified for admission to the University of Washington based on his teaching experience at the family-owned Kildall Nautical School rather than his high school grades.

Gary entered college and married his high school sweetheart Dorothy McEwen in 1963. He was one of 20 students accepted into the university's first master's program in computer science. Here, his mathematical talents were applied to a subject that fascinated him: all-night sessions programming a new Burroughs computer. To avoid the uncertainty of the draft at the height of the Vietnam War, on graduating with a Ph.D., he entered a U.S. Navy officer training school and was posted to serve as an instructor in computer science at the Naval Postgraduate School (NPS), Monterey.

Gary remained at NPS as an associate professor after his tour of duty ended in 1972. He became fascinated with Intel Corporation's first microprocessor chip and simulated its operation on the school's IBM mainframe computer. This work earned a consulting relationship with Intel to develop PL/M, a high-level Programming Language for Microcomputers that served the company for decades.

To design software tools for Intel's second-generation processor, he needed to connect the chip directly to a new 8" floppy disk-drive storage unit from Memorex. He wrote code for the necessary interface software that he called CP/M (Control Program for Microcomputers) in a few weeks, but his efforts to build the complex electronic hardware required to transfer the data failed. The project languished for a year. Frustrated, he finally called John Torode, a college friend then teaching at U.C. Berkeley, who crafted a "beautiful rat's nest of wirewraps, boards and cables" for the task.

"One of the most exciting days of my life."

On that fateful day in 1974 in the backyard workshop of his home at 781 Bayview Avenue, Pacific Grove, Gary "loaded my CP/M program from paper tape to the diskette and 'booted' CP/M from the diskette, and up came the prompt: *. This may have been one of the most exciting days of my life, except, of course, when I visited Niagara Falls," he exclaimed. "We now have the power of an IBM S/370 [mainframe computer] at our fingertips." This is going to be a "big thing," they told each other.



The Kildall Family home, 781 Bayview Avenue in the 1970s

As Intel expressed no interest in CP/M, Gary was free to exploit the program on his own and sold the first license in 1975. He continued teaching part-time at NPS, and in 1976, with his wife Dorothy as co-founder, they established Intergalactic Digital Research to pursue more commercial opportunities. They shortened the company name to Digital Research Inc. (DRI) when it became available.

Glenn Ewing, a former NPS student, approached DRI with the opportunity to license CP/M for a new family of disk subsystems for fast-growing microcomputer maker IMSAI, Inc. Reluctant to adapt the code for another controller, Gary worked with Glen Ewing to split out the hardware dependent-portions so they could be incorporated into a separate piece of code called the BIOS (Basic Input Output System).

Before CP/M, computer manufacturers designed their operating systems to work only with their own hardware and peripheral equipment. An IBM OS would only work with IBM computers; a Burroughs OS only with Burroughs computers, etc. Applications had to be written for the specific OS of each computer. Such "closed systems" made it difficult or impossible to mix and match the best pieces of equipment and software applications programs from different manufacturers.

The BIOS code allowed all Intel and compatible microprocessor-based computers from other manufacturers to run CP/M on any new hardware. This capability stimulated the rise of an independent software industry by expanding the market's potential size for each product. A single program could run without modification on computers from multiple manufacturers, laying an essential foundation for the personal computer revolution.



716 Lighthouse Ave. The upper floor is now a private residence. Photo: David A. Laws

Dorothy and Gary opened their first office on a rented upper floor with a view of Monterey Bay at 716 Lighthouse Avenue, Pacific Grove. They sold CP/M disks for $70 a copy and walked to the post office every workday to pick up checks resulting from ads placed in industry magazines such as *Byte* and *Dr. Dobbs' Journal of Computer Calisthenics and Orthodontia.*

A licensing deal with IMSAI bestowed credibility across the industry. CP/M became accepted as a standard and was offered by most early personal computer manufacturers, including pioneers Altair, Amstrad, Kaypro, and Osborne.



DRI staff outside 801 Lighthouse Avenue, Pacific Grove in November 1980. Photo: John Pierce

In 1978, revenue topped $100,00 per month, and DRI purchased a Victorian house at 801 Lighthouse Avenue for the company headquarters. By 1980, DRI employed more than 20 people, and Fortune magazine reported that the company generated revenue of $3.5 million. This was five times the revenue of Microsoft at that time.



Gary with the Piper Turbo Arrow at Monterey Airport. Photo: Tom Rolander

Gary also acquired a Piper PA-28RT Turbo Arrow aircraft that allowed him to fly from Monterey to meet regularly with his customers in Silicon Valley and beyond.

To accommodate the expanding engineering staff hired to service the hundreds of different computer models used by more than a million people worldwide, DRI purchased a 1909 American Foursquare-style residence across the street at 734 Lighthouse. Today, it houses the offices of the Carmel Pine Cone newspaper.

Gary occupied a corner office overlooking Lighthouse Avenue. One Friday afternoon, he called the engineering staff together and announced that he would give them all a raise over the weekend. On Monday, when they returned to work, contractors began to lift the building



Gary at work in 734 Lighthouse. Photo: John Pierce

to make room in the basement for a new Digital Equipment Corporation VAX 11/750 computer system. After several weeks, supported by heavy wooden beams and house jacks, the engineers' desks were five feet higher.



The DRI Engineering building before and after the "raise." The unpainted boards at right show the raised area. Photo left: Heritage Society Archives. Right: John Pierce

By 1983, DRI annual sales reached $45 million, the company employed over 500 people, including more than 100 engineers, and had expanded into another building at 160 Central Avenue that today houses offices of the Monterey Bay Aquarium.

The IBM PC Effect



With Bill Gates at a technology conference. Photo: Amitesh Jasrotia

In 1980, IBM established a new business division in Boca Raton, Florida, to develop a desktop computer for the mass market. To get the IBM PC, as it became known, to market as quickly as possible, they used commercially available components, including an Intel microprocessor chip. Bill Gates knew Gary from early discussions about merging their companies and setting up shop in Pacific Grove, so when an IBM procurement team visited Microsoft to license the BASIC interpreter program, he referred them to DRI for an operating system.

When the IBM team arrived in Pacific Grove, they met in the morning with Dorothy and DRI attorney Gerry Davis to agree on the terms of a non-disclosure agreement. Gary, who had flown his aircraft to Oakland to meet an important customer, returned in the afternoon, as scheduled, to discuss technical matters. The meeting ended in an impasse over financial terms. IBM wished to purchase CP/M outright, whereas DRI sought a per-copy royalty payment in order to protect its existing base of business. With some alternative approaches in mind, Kildall tried to renew the negotiations a couple of weeks week later, but IBM did not respond.

In the meantime, Bill Gates had purchased an OS from Seattle Computer Products that was written to emulate the look and feel of CP/M. He then sold a one-time, non-exclusive license to IBM, which used the designation PC DOS. With great foresight, he retained the right to license the product to others as MS-DOS.

When Gary learned of this transaction, he threatened IBM with a lawsuit over what he believed was an illegal copy of CP/M. IBM responded by agreeing to fund DRI to write a version of CP/M for the PC and to make both brands of OS available to customers. With CP/M's reputation and enhanced features, Gary believed customers would opt for the better product.



Dorothy and Gary review an advertisement promoting CP/M for the IBM PC. Photo: DRI

IBM announced the PC on August 12, 1981, but with the PC-DOS list price set at $40 versus $240 for CP/M, most customers simply chose the former as the lower-cost option. Gerry Davis is quoted in the book *They Made America* that "IBM clearly betrayed the impression they gave Gary and me."

Aftermath

DRI continued to thrive for several years with a multi-tasking operating system for the IBM PC-XT and a host of new products. The company also introduced operating systems with windowing capability and menu-driven user interfaces years before Apple and Microsoft.

In other pursuits, Gary founded KnowledgeSet with his friend and DRI VP of engineering, Tom Rolander, where they created the first CD-ROM encyclopedia for Grolier.



Tom Rolander with Gary in a photo booth on Cannery Row in 1980. Photo: Tom Rolander

In an oral history for the Computer History Museum, Brian Halla, Intel's technical liaison to DRI, recalls that Gary "showed me this VAX 11/780 that he had running in his basement, and he was so proud of it, and he said, 'I figured out a way to have a computer generate animation,' and he said, 'Watch this. And he runs a demo of a Coke bottle that starts real slowly and starts spinning, and so as maybe several months went by, he lost interest in this, and he sold his setup to a little company called Pixar.'"

At its peak, DRI employed over 500 people and opened operations in Asia and Europe. However, by the mid-1980s, in the struggle with the juggernaut created by the combined efforts of IBM and Microsoft, DRI had lost the basis of its operating systems business. Dispirited, Gary, who never relished the responsibility of managing a large company or displayed the cut-throat business acumen of a Gates, sold the company to Novell Inc. of Provo, Utah, in 1991. Ultimately, Novell closed the California operation and, in 1996, disposed of the assets to Caldera, Inc., which used DRI intellectual property assets to prevail in a lawsuit against Microsoft.

After leaving DRI, Kildall continued to innovate. He moved to Austin, Texas, where he founded Prometheus Light and Sound to explore wireless home networking technology and participated in charitable work for pediatric AIDS.

Gary Kildall died at age 52 following an accident in Monterey in 1994. His ashes are buried in Seattle, the hometown that he shared with Bill Gates. After they divorced, Dorothy McEwan Kildall purchased the Holman Ranch in Carmel Valley and served on many community boards, including the Heritage Society of Pacific Grove. She died in 2005.

The Legacy of Gary Kildall

In 1995, the Software and Information Industry Association presented a posthumous Lifetime Achievement Award to Gary Kildall, citing eight significant areas in which he contributed to the microcomputer industry.

On April 25, 2014, the Institute of Electrical and Electronic Engineering, "The world's largest professional association for the advancement of technology," installed a bronze IEEE Milestone in Electrical Engineering and Computing plaque outside the former DRI headquarters at 801 Lighthouse Avenue. The Milestone program honors important events in electrical engineering and computing. Achievements such as Thomas Edison's electric light bulb, Marconi's wireless communications, and Bell Labs' first transistor are recognized with plaques in appropriate locations. The citation reads: "Dr. Gary A. Kildall demonstrated the first working



prototype of CP/M (Control Program for Microcomputers) in Pacific Grove in 1974. Together with his invention of the BIOS (Basic Input Output System), Kildall's operating system allowed a microprocessor-based computer to communicate with a disk drive storage unit and provided an important foundation for the personal computer revolution."

In 2017, U.S. Navy dignitaries, friends, family, and peers gathered to celebrate the dedication of the Gary A. Kildall Conference Room on the Naval Postgraduate School campus in Monterey. The ceremony included the installation in the conference room of a duplicate of the IEEE plaque.

Despite this wide recognition of his technical accomplishments, Gary's legacy remains mired in a tangle of myths and conspiracy theories. The most persistent being driven by a 1982 comment attributed to Bill Gates and published in the London *Times* newspaper that "Gary was out flying when IBM came to visit, and that's why they did not get the contract."

The former editor of *The Times*, Harold Evans, atoned for that story in a PBS documentary and his book *They Made America: Two Centuries of Innovators from the Steam Engine to the Search Engine.* The subtitle of the chapter on Gary, "He saw the future and made it work. He was the true founder of the personal computer revolution and the father of PC software," offers a sympathetic telling of the life and times of the entrepreneurial genius who helped give birth to the PC operating system 50 years ago this year.

Note: Comments in quotes without a source attribution are from the draft of Gary's 1993 unpublished memoir titled *Computer Connections: People, Places, and Events in the Evolution of the Personal Computer Industry.*



A familiar local character appeared in advertisements for the DRI version of the Logo programming language

The Heritage Society of Pacific Grove
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