My Life and Times at SIO

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Before commencing this brief discourse on my forty years at SIO (1947-1987), I wish to acknowledge my great appreciation of the fortuitous circumstances that made it possible for me to spend the bulk of my working career doing research of my own choosing, in a new field, and in the pleasantest of atmospheres, largely unimpeded by administrative and financial constraints. These unique circumstances no longer exist. Oceanography today is a team effort, involving large numbers of researchers, many ships, and is often multi-institutional. Only a handful of my early colleagues remain to recall the best of places in the best of times.

I came to SIO quite by accident. After graduating from Stanford in engineering physics, I married skier Nancy Chapin and spent the WWII years working in aircraft and rocket design. A postwar slump left me looking elsewhere—hopefully in La Jolla, where I had spent many boyhood summers. A social friend, Walter Munk, at that time married to my Nancy's sister, Martha, had just completed his postgraduate work at Scripps. He suggested that I join his small research group to design instruments. I was interviewed by director Harald Sverdrup, who invited me to come, either as an engineer or as a graduate student, stating: "the pay's the same, but I think your long-term prospects will be better as a student." I enrolled as a student in fall 1947, and never looked back.

At that time Scripps comprised a cluster of three small buildings, linked by second-story bridges, a semi-circle of shingled cottages for a dozen faculty and staff members,[1] a 110-ft. wooden schooner, and a decrepit pier: “perpetually in need of repair.” A tennis court was centered on the large lawn east of the library . There were no houses in La Jolla Shores. Scripps was connected to town by a two-lane road that wound its way down the hill from Highway 101 to Ardath Road. A pastoral setting unblemished by distant La Jolla, a retirement community, where old people came and brought their parents; Pearl Street was the edge of town and San Diego was in another Universe.

My class at Scripps included seven other students, Palmer Osborne, Townsend Cromwell, Jack Wickham and four Argentine naval officers. The Argentines were honor students who left after obtaining their Masters degrees. The only bachelor, Hector Etchebehere, threw frequent parties, where we danced the tango until we dropped.

There were also about fifteen post-military trainees from a class ahead of us, many of whom left Scripps without being granted degrees through failure to pass the required language exams. Nevertheless, several persevered, becoming ONR functionaries or founding and becoming directors of other oceanographic institutions. To my knowledge, Doug Inman and I remain the only survivors of this group at SIO.[2]

Most of us graduate students lived in abandoned Marine NCO quarters on the site of the present married student housing. We called the area “Torrey Pines Tenements,” from which the squalls of newly born infants (including my first) pervaded an otherwise studious atmosphere.

Despite a heavy course load, I was sent to Hawaii over the Christmas holidays in 1947 to install a “long-wave” recorder at the end of (no longer existing) Mala Pier in Lahaina, Maui. My instrument was a much-simplified version of an earlier design, constructed by Walter, Hector Iglesias, and Ted Folsom, which had been operating for several years at the end of the Scripps pier. Records from the Scripps instrument were virtually useless because of surf noise, but those from Maui were almost noiseless and revealed a pronounced spectrum of long wave activity, which Walter interpreted as resonant oscillations of the basin between Maui, Lanai, and Molokai Islands. These results awakened my interest in long waves, which was to become my principal research focus.

My second year (1948) was marked by completion of required graduate courses, the addition of three “temporary” war-surplus offices buildings on the site of the present director’s office (two for student offices and one as our first instrument shop), the departure of most of our post-military students, and the infusion of a new crop of

graduate students. The latter included Chip Cox and Joe Reid, both of whom survive today as Professors emeriti at SIO.

Chip lived aboard a 110-ft. WWII PC boat, purchased for a pittance from navy war surplus. He scrapped the interior and installed refrigeration and remote engine controls so that, except for anchoring, he could operate the vessel single-handed from the bridge. But fishing interfered with studying, so he leased the boat to a scoundrel who sailed off to Ecuador and never returned.

I spent that summer studying for my German exam and building a small house in La Jolla at the end of a winding dirt street off Windansea Beach. I also learned to surf, spurred on by Towny Cromwell, who had built a house next door. Towny and his wife, Kay, then engaged Nancy and me in a baby race, in which we were soon outnumbered, thus firmly establishing Cromwell's Law that all SIO children conceived in La Jolla are female.

Cromwell got his degree under visiting Professor Ray Montgomery, but was killed in an air crash in 1958 after having discovered the equatorial Pacific undercurrent that bears his name.

Fall 1948, marked the departure of much beloved Harald Sverdrup to head the Norwegian Polar Institute and the appointment of Carl Eckart as SIO's (surrogate) director, whilst LCDR Roger Revelle, acting director in absentia, served out his naval commitment at ONR.

As a 1936 Scripps graduate, and a prime mover in the wartime navy's newly established Office of Naval Research, Revelle was ideally suited to advance his concepts of oceanographic research, leading, largely through his efforts, to the founding of a new University of California branch in La Jolla.

Through Eckart, Roger began the transmogrification of a small biologically oriented research institute into a burgeoning multifaceted oceanographic hydra. Roger commenced by luring ocean- or earth-science related individuals or entire groups from other institutions to come and work at Scripps, expanding facilities or constructing new buildings to accommodate them. He brought down ocean engineer John Isaacs and his assistant Willard Bascom from Berkeley, and chemist Ed Goldberg from Chicago. He incorporated the UC Division of War Research on Point Loma, including physicists Carl Eckart, Leonard Liebermann, Russ Raitt, and Fred Spiess. He borrowed buildings and pier space from the navy electronics facility on Point Loma, purloined three fleet tugs from the navy to support our marine operations (Horizon, Baird, and Paolina T.), and built a radio station atop the hill behind Scripps to keep track of them. And all this before the end of 1951, when I first met Roger Revelle, who then succeeded Carl Eckart as director of SIO. Meanwhile, all but unwitting of the gathering storm, I completed my measurements of wind stress on the Mission

Bay yacht pond and began to write my dissertation. These measurements stand today as the most reliable ever reported.[3]

The winter of 1952 brought a sequence of events that was to shape my life for the next three decades. The first was President Truman's authorization for the Los Alamos Scientific Laboratory (LASL) to proceed with the construction and testing of the world's first thermonuclear fusion device (H-Bomb) at Eniwetok Atoll, Marshall islands, scheduled for November. Operation IVY was a deeply secret project that received only token announcement. The second was the planning and execution of SIO's longest two-ship geophysical cruise, Capricorn expedition, scheduled for September, 1952.

These two events were connected coincidentally by Edward Teller's announcement at a late March LASL planning meeting that Mike might release as much as ten times the energy estimated when the design had been frozen the previous November.[4] This quantum escalation required revision of the IVY Op-Plan to include evacuation of 12,000 people from the atoll and firing the device by radio from a ship at sea instead of from a bunker on the atoll. It also provoked inviting Scripps expertise regarding the possibility of blowing away the atoll rim and generating an "artificial" tsunami of potentially dangerous proportions.[5]

Accordingly, Capricorn was rescheduled to include participation in IVY to the extent of geophysical examination of atoll structure for explosion sensitivity, and installation of wave measuring instrumentation within and without the atoll and upon six distant islands. In case dangerous waves were generated, arrangements were made for a false “tsunami” alert from the newly established Tsunami Warning System in Hawaii.

After much discussion at SIO, John Isaacs was put in charge of intra-atoll observations, Willard Bascom, aboard the Horizon, would plant two moored raft-recorders on top of nearby seamounts, and I would provide portable long wave recorders and supervise their installation by graduate students on six remote islands. Walter Munk aboard the Horizon would interpret raft signals to Isaacs aboard the task force command vessel, *Estes.*

It was an exciting time. Mike was detonated on Nov.1, only exceeding his design energy by a factor of three (10.5 MT). But the explosion crater, a mile across, came within ten yards of bursting into the ocean. Walter wisely deigned to report a recording glitch as a giant wave, which would have triggered a tsunami alert. But the Horizon was clobbered by fallout when a wind shift blew the mushroom cloud in her direction as she desperately sought to escape. Significant waves were recorded at all my distant islands. Then, on November

fourth, the second largest “natural” tsunami of the century radiated from a magnitude 8.2 earthquake off Kamtchatka, Russia, producing waves that inundated Waikiki, destroyed my wave gages in Hawaii and Guam, and washed away the new Officers Club on Midway Island after I had just assured the island commander that it was perfectly safe. Had that earthquake occurred *three* days earlier, hardly anyone cognizant of Operation IVY would have considered it an accident.

After the test, the Horizon was rejoined by the Baird, bearing Roger Revelle, and sailed southward on Leg II of Capricorn, returning by way of Fiji, Tahiti, and the Marquesas Islands three months later. But I remained in Hawaii for ten days conducting a survey of wave damage.[6]

Following IVY’s hairbreadth escape from calamity, totally unbeknownst to the real world, SIO’s participation in Pacific nuclear testing became a permanent Task Force function that was to last another six years. John Isaacs continued to head up central area activities, while I maintained distant island stations. Isaacs’ responsibilities expanded to using the Horizon to monitor ocean radioactivity from fallout, later continued throughout his career by Ted Folsom. My observations also extended to year-round monitoring of natural tsunamis at permanent stations on three key islands, Wake, Johnston, and Canton, using a permanent crew of diver-technicians.

My activities increased during the International Geophysical year (1956-1957) to include Palmyra, Fanning and Jarvis Islands, and Tahiti, Rurutu, and Takaroa in French Oceania. In 1961, during Operation Dominic at Christmas Island, I was appointed task group commander, having sole responsibility for SIO participation. Dominic lasted seven months, interrupted only by a quick trip to Norway to review tide gage evidence for waves generated by the 60-megaton Russian bomb test over Novaya Zemlya.

All of our island installations required a great deal of scuba diving, involving setting anchors in soft coral at 200 feet to minimize wind waves, and anchoring heavy electric cable across flat table reefs to recorder shelters above sea level. Our diving gear advanced with the times, from the original dual-hose Aqualing, mounted on a tank strapped to one's back, to a comfortable back pack, with twin tanks and single hose leading to a mouthpiece equipped with a demand valve. Our equipment was maintained in a special shop at a new SIO Diving Facility headed by Jim Stewart and Earl Murray, who conducted mandatory training classes. My group carried special Task Force orders allowing us to ship our diving boat and a ton or two of equipment at any time to any place aboard military aircraft. Altogether, we logged upwards of one million travel miles during

nearly fifteen years of continuous Pacific operations, including three trips to tiny Marcus Island, via Japan.

Meanwhile, during the early fifties, La Jolla grew prodigiously. The desert of La Jolla Shores became sprinkled with homes. At SIO. Vaughn Hall was built to house the new aquarium. Ritter hall was extended south and linked by a bridge to new Sverdrup Hall, further linked to new Sumner auditorium. Roger invited Per Scholander and his Scandahoovians to SIO and built them a Physiological Research building. Scholander, like Kipling's Elephants Child, was curious about most everything: how mosquito larva could live for years trapped in ice which was opaque to oxygen; how birds could walk on ice without their feet freezing; how giraffes could pump blood up a 12 foot neck. We spent many a happy vacation together.

Roger also brought in Gus Arrhenius, Harmon Craig, and Hans Seuss to date sediments using isotope chemistry. He brought in Dave Keeling to do atmospheric chemistry. He got Vic Vaquier to study paleomagnetics, and Ben Volcani to study diatoms. He fostered Walter Munk's appointment as head of SIO's new Institute for Geophysics. Walter later got his own new redwood building, designed by famed architect Richard Neutra, and lured a host of future IGPP faculty, the first of whom were George Backus and Freeman Gilbert.

Among new institutes were the Visibility Laboratory, under Seibert Duntley, and the California Cooperative Fisheries Investigation, headed by John Isaacs. Isaacs was my titular boss during the testing years, with whom I attended planning meetings and filed reports. Jphn was an unique entity of large proportions and prodigious intellect. He excelled at manipulating people, including Roger Revelle and Walter Munk, themselves skilled manipulators. Without ever graduating from college, he managed to become a full professor of Ocean Engineering in UCSD's department of Applied Mechanical and Engineering Sciences (AMES), which he helped establish. He worked tirelessly, wrote prodigiously, but never published anything. But he died of (self-diagnosed) cancer in 1978, and few today have any awareness of his former influence.

There were many other people of note in the early university, now mostly retired, but I cite only those with whom I enjoyed close relationships during my peripatetic career. To most, I was the mystery man, rarely glimpsed riding his Vespa up the sinuous grade toward his laboratory on the present site of the Carl Eckart Library, and who was reputed to give lavish parties at his mansion on Muirlands Drive. The "mansion" was my spare time domestic project of the early fifties, handcrafted of redwood, stone, and glass on 1.5 acres overlooking the golf course. Nancy and I were frequently

prevailed upon to recruit luminaries by showing them how assistant professors lived in La Jolla. I can recall having as many as four Nobel laureates to dinner at one time.[7]

Having a research appointment and being frequently away on classified business, I was not privy to--and scarcely cognizant of--planning for the new university, except that most newly recruited faculty were housed in ***our*** new buildings, whilst ***their*** new buildings were being constructed up on the east side of Highway 101. The new physics department nucleus of Keith Brueckner, Bernd Matthias, and Leonard Liebermann became my closest friends throughout the remainder of my career at SIO, and remain so even now, long after retirement.

Matthias, the caricature of a mad scientist, had a split appointment between Bell Labs, Los Alamos, and UCSD. He worked in his lab only at night, trying endlessly to discover the world's highest-temperature super conducting compound. His interest in ESP prompted me to agree that the first of us to die would attempt to communicate with the other on the anniversary of his death. Bernd died in 1980 and, on his anniversary, Nancy and I were picnicking on the San Miguel river in Colorado with Bob and Priscilla Duffield, long term friends from Los Alamos and La Jolla. It was a beautiful sunny day, when suddenly black clouds rolled over the canyon rim and a

lightening bolt sundered a tree 100 yards away, setting it on fire. “That’s enough, Bernd,” cried Nancy, the only one of us who remembered our long—forgotten agreement. Bernd responded with another bolt a mile away, and then rumbled away in the distance.

One of my chief—and unnoticed—accomplishments at Scripps came in late fall, 1957, immediately after the Russians launched little Sputnik, the world’s first orbiting satellite. Being familiar with nuclear explosion hydrodynamics, I conceived the idea for a Jules Verne-type cannon, fifty feet across and two miles deep, and capable of putting a 500-ton projectile into orbit. Dropped from the top, the projectile compressed hydrogen and was accelerated upwards on the rebound by detonating small atomic explosions beneath it. Leaving the bore at 50,000 feet per second, like an enormous meteorite, the projectile was nudged into orbit by self-contained solid propellant rockets.

After working nonstop through the Christmas holidays, I flew to Los Alamos and Armour Institute to have my hydrodynamics and shock calculations checked out. Then, on to Washington to see my sponsors at ONR, with much encouragement. There, I confided my idea to Willard Bascom, who, after Capricorn, had left SIO to become secretary of the National Research Council. “The navy will just sit on it,” he said. “I’ll take you to my friend Nelson Rockefeller (then head

of Government Operations) who will arrange for you to meet President Eisenhower."

Eisenhower's secretary suggested that we first confer with James Killian, his science advisor. But, in Killian's absence, we talked instead with his new deputy, Herb York, who had just resigned directorship of UC Berkeley's Livermore Laboratory. "Very interesting," agreed York, "but I think you should drop by Livermore first for a second opinion." At Livermore, I conferred with director Harold Brown, who later succeeded York as Defense Secretary, and John Nuckols, recently Livermore's director after Brown. "Very interesting," they said, "but we'll need a week or two to check it out." Then, nothing; my project was too secret for me to access.

Two years later I was retained as consultant to a large contractor to explore the means and cost of digging a two mile hole fifty feet across. It was an urgent Top Secret Livermore project, entitled Project GASP (Ground Accelerated Space Platform), with AVCO as prime contractor. Then, in 1962, president Kennedy signed a moratorium with Russia against all atmospheric testing of nuclear weapons, and the whole thing was dropped. I didn't even get a letter of thanks. But then, Enrico Fermi patented the first chain-reacting pile and had to sue the government many years later to collect.

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The 1960's brought about great changes in my way of life. I found myself spending sixty per cent of my time at SIO and forty per cent in the field, instead of the reverse. Further, my family knew where I was and how long I might be gone. Pacific nuclear testing ended and the last two tsunamis of the century occurred in 1960 and 1964, providing me with a wealth of material for publication. Lastly, we were engaged in a cold war with Russia and a hot war in Viet Nam. The space race raised the specter of nuclear missiles, and the attendant possibility of offensive and defensive damage from waves produced by explosions in a marine environment. I became a member of an AEC committee responsible for exploring such possibilities, and spent a good part of that decade directing experiments and doing calculations that ultimately led to the Van Dorn Effect, the blockading of coastal shelves by waves produced by explosions in deep water offshore. This classified work was eventually revealed by inadvertent reference to it in the Congressional Record, in connection with the emplacement of missiles in mini-subs cruising the continental shelves.

Perhaps my most significant unclassified work during the 1960's was to show that the multi-ring mountain structures surrounding the largest lunar craters exactly fitted the wave pattern from an explosion in water of finite depth, if "frozen" at times corresponding to the cube-root of explosion energy.[8] This result, obtained from lunar orbiter

photographs five years before the Apollo landings, I interpreted to mean that the primordial moon was internally hot enough to melt spontaneously during the temporary pressure rarefaction behind the shock wave from an impacting meteorite. The high-density layer upon which the “waves” traveled was found to be 55 km, as later verified by seismometers implanted by the Apollo astronauts. Did I discover the relic Moho on the moon? Only time will tell, but the four basalt rings surrounding the Chicxulub impact in Yucatan fit my generalized lunar curves perfectly, provided one takes the local Moho depth (35 km) between the earth’s mantle and crust as the rigid layer upon which the waves propagated.

Meanwhile, during the 1960’s, and largely due to Roger Revelle’s unremitting efforts, the first two colleges of the new university burgeoned on the mesa above SIO. Aside from gaining the UC regents’ commitment and funding approval, this program involved relocating Highway 101 a quarter mile west, dislocating Miramar road a mile east, and acquiring 3400 acres of land from the military, the City of San Diego, and private interests. Despite these impressive achievements, Revelle’s somewhat abrasive tactics, resulted in his being denied the first chancellership of UCSD in favor of my old nemesis, Herb York. After a brief stint at Berkeley as Dean of Graduate Sciences, Roger left SIO for Boston to head Harvard’s new

Institute for Population Studies. These events and the subsequent growth of UCSD to rival UCB and UCLA are well detailed a recent book.[9]

Nancy, and I formed many friendships with (now) Revelle and Muir College faculty members, including UCSD's second chancellor, John Galbraith and his gracious wife Laura. In fact our social circle from then on included mostly UCSD people, except for Bill Nierenberg, who superceded Roger as director of SIO. Among campus liberals, Bill was considered slightly to the right of Attila the Hun, but we shared common interests, including flying,[10] and he was at least privy to and appreciative of my classified work. In my opinion, Nierenberg was the best SIO director during my forty years of residence.

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Having since early youth been vocationally involved with boats and boating, and having chartered sail or power boats for summer vacations since my graduate days at SIO, it occurred to me in 1969 to write a semi technical book combining my experience with boats with that in oceanography. Fortuitously, my first proposal resulted in a contract with Dodd Meade, whose owner, Edward Dodd, took it on as a personal project. *Oceanography and Seamanship* took five years to complete, aided by many experts at SIO and elsewhere. My son, Richard, took a summer off to do the drawings. Published in 1974,

O&S has enjoyed international success through two editions and six printings. I am told that it is still a principal reference on ship behavior in storm seas at the naval and maritime academies and by the Coast Guard. Quite an accolade?

Throughout this period I had three graduate students doing wave experiments on deep and shallow water wave breaking in the SIO hydraulics laboratory. One of them I flunked for fudging data, one became an NSF program reviewer, and the last prospered at SIO's new climatologic facility. These students comprised my only specific career teaching responsibility.

During the 70's I also co-authored two papers with UCSD physicist W. B. Thompson showing that coastal response to incoming long waves can be calculated from first principles.

In 1975, ONR lost interest in waves, and ceased its automatic support of my activities. I was forced to lay off three career-long technicians. At the same time, the City found reason to reappraise our La Jolla residence and quadruple our taxes. With no recourse, Nancy and I sold our La Jolla mansion in a depressed market and built an architecturally distinctive home on a small Del Mar lot. It was in a distinguished neighborhood and had a magnificent view of the ocean across Torrey Pines Reserve. But our 300-ft. driveway had shrunk to 25-ft. !

Fortunately, I was invited to Join Doug Inman's new Coastal Engineering Research Center (CERC), and spent the next two years attempting to devise means for minimizing sediment accumulation in navy berthing facilities; interesting engineering work, but with little scientific reward. Meanwhile, Nancy went into condo resales, buying uncompleted multiplexes for a song, finishing and decorating them, and then rolling them over into larger and more attractive units.

Our resources recouped, I was contemplating retirement when I was appointed chairman of the Physical Oceanographic Research Division, and onerous position that involved little else than selecting committees to review academic appointments and staff hirings and firings. I soon discovered that it was impossible to fire people from the UC system. They could appeal endlessly! Handling only a dozen endless appealers took all my time. I wrote a note to Nierenberg submitting my retirement and recommending that the Chairman of PORD should receive reimbursement and have three assistants. He acceded to both requests; I was retired on December 31, 1979, and Russ Davis succeeded me as PORD chairman-- for which he has never forgiven me.

With newfound freedom, Nancy and I bought a motor home and commenced a six-month tour of the western United States, ending up with the purchase of a ski chalet in Telluride Colorado. We had met

skiing, and had spent most winter vacations at ski resorts throughout the west. We rented the Del Mar House, and for two years, enjoyed the nirvana of retirement. Nancy took up weaving with a vengeance, and I wrote my classic novel about IVY MIKE.

But ultimately, the work ethic set in. We returned to Del Mar and I sought re-employment at SIO. I could supplement my pension by working up to half time. I found that the Defense Atomic Support Agency (DASA) had a renewed interest in the Van Dorn Effect, and went back to work on the “tsunami” problem.

Having previously shown that the energy decay rate of tsunamis in the Pacific Ocean was independent of the position of the recording station, I obtained, not without some difficulty, tsunami records from the eastern Mediterranean, the Gulf Of Corinth, and the Sea of Japan. These water bodies are all essentially enclosed, but still retain Pleistocene shelf margins at 200 m depth, as does the Pacific. Lastly, by assuming that all dissipation takes place on the shallow shelves, I was able to show that a common decay coefficient suffices to explain long wave energy decay in all seas when applied only to the shelves, the deep basins acting merely as reverberating energy storage. When applied to the tides, the same coefficient accounts for about half the total dissipation deduced from astronomical observations, the other half having been previously attributed to turbulent flow through

narrow channels and shallow seas.[11] Published in 1987, this paper marked my last on-campus contribution, after which I gave up my office and worked at home in Del Mar. During the past 17 years, however, I have:

1. Published a second edition of Oceanography and Seamanship.
2. Written a classified history of the Super Project (Development and testing of the hydrogen bomb) for Los Alamos archives.
3. Published a volume of my publications: Papers in Physical Oceanography, paid for and distributed to most oceanographic facilities in this country.
4. Published two papers in the Journal of Biochemical Engineering concerning human power production and cold water survival; both are included in the above book.
5. Survived the sudden death of my lovely wife, Nancy, married lovely Jane Van Osdol, CFO of a large Seattle corporation, sold my lovely Del Mar home, and moved to a very charming retirement facility in La Jolla. We travel quite a bit!
6. Published a narrative history of Scripps's participation in Operation Ivy, entitled: Ivy-Mike the First Hydrogen Bomb, and established a website to promote it: www.wgvandorn.com.

For comments, questions, or answers, I can still be reached at wvandorn@ucsd.edu.

REFERENCES

1. Harald Sverdrup, Martin Johnson, Carl Hubbs, Claude Zobell, Norris Rakestraw, Francis Shepard and Walter Munk. Two secretaries, a librarian, and an invaluable groundskeeper, John Stackleberg, the only person who knew where the underground utilities ran.

2. See Scripps in the 1940s; The Sverdrup Era, by D.L. Inman, Oceanography, Vol.16, No.3, 3/2000.

3. Wind Stress on and Artificial Pond, J. Mar. Res.,v.12. no.3, December 31, 1953, pp. 249-276.

4. Teller's upper estimate was 100 megatons of TNT, roughly equivalent to ten freight trains of TNT extending from Los Angeles to New York.

5. Roger and Walter had previously assisted in the Baker atomic test at Bikini Atoll in 1946, regarding wave guestimates and atoll flushing.

6. Thirty years later, after retirement, I wrote a factional account of IVY, but was unable to publish it. Interested readers can download it from the SIO website www.???, under the title: IVY MIKE, The First Hydrogen Bomb.

7. Harold Urey, Maria Meyer, Richard Feynman, and Willard Libby.

8. AN IMPROBABLE VENTURE, A History of the University of California, San Diego, by Nancy Scott Anderson, USCD Press, 1993.

10. Tsunamis on the Moon?, Nature, v.220, no.5172, December 14, 1968, pp.1102-1107.

11. Bill's flying activities ended when he inadvertently landed his plane before lowering the wheels. Mine ended when my co-owner totaled our plane and himself.

12. Tide Gage Response to Tsunamis. Part II Other Oceans and Smaller Seas. J. Phys. Oceanography, v.17, no.9, September, 1987, pp. 1507-1516.

13. Sic transit Gloria van dorn