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By Willard Bascom

John Dove Isaacs was born in Spokane, Washington and raised in eastern Oregon where his grandparents had migrated in the 1850's as teenagers on wagon trains. His grandfather, also John D. Isaacs, was chief engineer of the Southern Pacific railroad for Leland Stanford and sported a private railroad car. A bronze plaque of Stanford University credits him with proposing the principle of making motion pictures, an idea carried to completion by Edward Muybridge. John's father, also a railroad engineer, died in a hunting accident when he was only six. So young John, with mother Constance Despain and sister Emily, moved to the 120,000 acre Hay Creek Ranch, not far from Pendleton, Oregon. Ranch life gave him a solid background in practical ecology.

Early in life he showed intense scientific curiosity, a capacity for invention, and the instincts of a naturalist. Before he was 12 he had devised and built a successful hydrogen balloon that landed on the minister's roof and blew off a few shingles.

As a Pendleton high school student in the early 1930's, he proposed a means of detecting distant objects by means of reflected radio waves to his physics teacher. Unfortunately that fellow did not grasp the possibilities and thereby lost an opportunity to become a co-inventor of RADAR.

Young John enjoyed reading encyclopedias and he had an excellent memory. As an adult sometimes he would launch into detailed dissertations on esoteric subjects, such as the complex life cycles of oriental parasites, that he had read 20 to 30 years earlier.

In 1933 he joined the new Civilian Conservation Corps; there was a good supply of logging and construction accidents as well as stabbings and shootings so he became an accident investigator. Two years later John had become camp manager at Cape Perpetua, Oregon for the Resettlement Administration, a New Deal agency intended to open up more productive lands to dust bowl refugees. By the following year he had saved enough money to start college at Oregon State where two of the attractions were Mary Carol Zander and the free food on Sunday at her sorority house.

When school was out John got a job as a forestry service lookout on Mt. Hebo in the Siuslaw National Forest. When it wasn't raining this meant 24 hours a day duty atop a high tower accompanied only by Sampson, his trusty pussy cat. During the period Isaacs spent in Oregon's coastal forest he learned not only the names of all the trees and the undergrowth plants but the intricate relationship between them and how it changed with logging and fires. In later life when driving along the highway he would amuse himself, and sometimes his companions, by intoning the latin names of each species of passing tree. One of the monuments he leaves behind is the thousand trees he planted on his estate in Rancho Santa Fe, California.

In 1938 he moved to Astoria, Oregon just as a great run of albacore tuna appeared offshore. Everyone in town who could get to sea went after the albacore and John joined with a friend who owned a small boat, intending to do the same. The reliability of the boat's engine was in doubt so they tested it on a short run out to sea. Coming in the Columbia River entrance (always a scary experience in a small boat if there is much of a sea running) the engine quit for good. After frantic work made it clear there was no change of getting the engine running again, Isaacs decided the boat was doomed and would soon go up on the jetty. He put on the life jacket, advised the crewman to do the same, and committed himself to the river. He vaguely remembered seeing one large wave fling the boat on the unforgiving rocks and watching splinters drift away. After an hour in the water he was picked up by a passing tug who put him in a cold shower to warm him up. He remembered it as scalding, relative to the river.

The next day John and Mary Carol walked out on the jetty, now surrounded by much calmer seas. She found the only surviving relic of the wreck, his wallet.

Later in that year the two were married. The young married pair occupied the handsome captain's cabin and officer's quarters aboard an old sailing ship, the William Traylor, which was moored in a bay near the mouth of the Columbia River.

As a young commercial fisherman working out of the Columbia River Isaacs was outraged one day by a passing tourist who said something to the effect that "these fishermen don't know much about what they're doing". John, with a six foot three inch frame and one of the highest recorded I.Q.'s in the state of Oregon, suggested that this unwary soul sit down and observe while he dissected a salmon and explained in detail the function of each organ and tissue.

John Isaacs was a fisherman throughout his life and actually appeared to enjoy cold, wet, miserable weather as long as he could fish. He could think better with a fishing pole in hand. Some of his best thoughts about who eats whom in the sea, under what conditions, and how the sea's biological energy is distributed, developed during 50 years of random observations. Finally these were set down in a landmark piece in the Scientific American entitled "The Nature of Oceanic Life" -- illustrated, of course, with photos of deep sea creatures taken by his monster camera. But that was much later.

As a commercial fisherman with a 'big' boat for the pre-war years he, and sometimes Mary Carol, would fish out of the Columbia River sometimes going north to Grays Harbor or the Quillayute River, or south to Tillamook Bay. It was the perfect school for a someday oceanographer and it left him with an ever-ready bag of stories about attacks by killer whales, pariah boats surrounded by clouds of kelp flies, and shipwrecks on various bars and beaches of that rugged coast, as well as a good sense of the lore of the sea.

After two years of commercial fishing John and Mary Carol returned to school and spent the academic year of 1940-41 at Oregon State University. Following that he took a job with a survey crew on the construction of Tongue Point Naval Air Station near Astoria, Oregon. As various construction problems arose, John devised solutions that moved him rapidly up the job ladder. The ceiling beams in one building under construction flexed excessively, obviously because of poor design. So, Isaacs derived the formula for computing bending stresses in beams and redesigned the offending structure, "so the plaster below would stay on." When the chief engineer unexpectedly quit he was offered the job. In 1943-44 Isaacs studied at the University of California at Berkeley, recieving a BS in civil engineering, his only degree. While there he came to know and appreciate Dean Morrough (Mike) O'Brien and Professor Richard Folsom who greatly influenced his life.

From there on he spent his life with the University of California, beginning as a research engineer on the WAVES Project at Berkeley, which is where I met him. John's enthusiasm for the sea and his sense of humor attracted me to him at once and, after listening to him for two hours on our first encounter in 1945,I switched immediately from mining to oceanography. The following week we began surveying the beaches of northern California, Oregon and Washington using amphibious trucks (DUKWS), seaplanes, radiocontrolled cameras, and a small party of men who didn't mind daily dowsings in cold sea water. In the late 1940's at Berkeley he invented such things as a wave direction indicator using a Rayleigh disc, several varieties of wave meters, a wave propelled "sea-sled" to carry surveying rods thru the surf zone, and a means of measuring and modeling stress in torpedo nets. Later he and I worked together measuring the effects of nuclear explosions in Eniwetok and Bikini.

John Isaacs was present at four nuclear test series; on two of those he especially distinguished himself. The first was Crossroads in 1946. John's job was to measure waves from the blasts and for this purpose he arranged to have large aerial cameras (film size 9" x 18") set up on two camera towers on Bikini Island. These would be started a little before the explosion and simultaneously take a picture every 3 seconds for several minutes. This wave-measuring technique had previously been tested on the northern California coast but at Bikini the problem was a little different.

Since the objective of that first test was to learn the effects of an air burst and an underwater burst on a fleet of warships, it was necessary to know the exact distances between the explosions and specific parts of each ship. The ships were to be anchored and the original plan had been to run aerial photo sorties over the fleet a day or two before the shot. These were to have been assembled in a mosiac and so that the distances from ship to shot would be known. However, as any seaman knows, ships at anchor move about in a "watch circle" whose radius is the anchor line, which itself is at least three times the depth of the water (some 200 feet in Bikini lagoon). When an attempt was made to match successive lines of pictures this was found to be impossible; between photo runs some ships had moved several hundred feet. Since weapons effects decrease as the cube root of the distance, such errors in position were unacceptable. At the uncomfortable moment when this fundamental flaw in the great test was discovered, Isaacs proposal to use the wave-measuring cameras to triangulate ship positions was gratefully accepted. For months afterwards he had a group of people using a traveling microscope mounted on a large steel micrometer stage measuring photos and precicely computing the position of ships in the test fleet. The wave measurements became almost incidental. Using automatic cameras that fire every three seconds he had the fantastic luck to get a picture of Baker shot's lighted bubble breaking the surface.

Later, in 1954 during the Castle series at Bikini, John became very concerned about the possibility of the shots causing a tidal wave that would wash over some of the uslets where people were intending to stay during the shot. Some of us thought there was little liklihood of that happening because John was jokingly known as a "calamatologist" (who often foresaw unlikely calamities) but he had the ear of the Admiral. At the last minute, just to be on the safe side, that worthy ordered all people off the atoll except the firing team.

The first shot (Bravo) went with about twice the expected yield. When it did it destroyed many camp buildings on the islands and dumped very heavy radioactivity on the atoll. The firing party was trapped in the bunker for a time and no one went back ashore for several days. There was no substantial tidal wave but I am convinced that if Isaacs hunch had not been followed, lives would have been lost both to the blast and the subsequent radioactivity.

John Isaacs liked to think. The more complex the subject, the better he liked it. Some of his favorite topics were far from oceanography. They included such diverse matters as black holes in space, the ground waters of the upper Indus valley, growing food plants in saline water, and esoteric aspects of mine warfare. He did not think in mathematical terms, but in later life he wrote equations for ideas that to him were self-evident.

John philosophized about a great many diverse subjects including economics ("The more money is expended for nothing, the more it approaches nothing as a value" and Whitehead's universe where "the possibilities are not only infinite but actual"). He invented Epimetheus (the hind-thinker) rampant on a field of greenbacks, who proposed panaceas for vaguely defined scientific problems. And he worried about the communications disjuncture between those who posess scientific understanding and those who are responsible for the directions of governmental action.

John was a big man with very quick reaction but he was not athletically inclined and never showed the slightest interest in swimming or ball games. Instead he tended toward games that maximized his talents so he could win. His favorite of all was one in which two persons face each other, hands are below, barely touching, with palms up. The object is for the hands below to slap the back of the hands above. No one came close to beating Isaacs at this. He was also expert at ping pong and delighted at teaching it to graduate students who had an overly high opinion of their prowess. He loved chess, including blind chess, Kriegspiel and triple cylindrical chess, but had a hard time finding worthy opponents.

Isaacs had a marvellous sense of humor that began at the lower end of the range with outrageous puns and extended upward to jokes that were so sophisticated that almost no one would get the point. Having relieved himself of some such witicism he would cautiously look around the audience to see if anyone had caught on.

On such occasions I would just perceptibly move my head from side to side to show his remarks had not gone completely unnoticed -- but as a matter of principle I never cracked a smile. John was in his glory when it became fashionable to devise a horrid form of joke known as Tom Swifties. As with puns he was always trying to invent ones with double and triple meanings. These were marvellously idiotic and when we all laughed he would be encouraged to attempt an even more outrageous version. It is just as well that none of the survivors of those encounters can remember any of the dozens he exuded; they might not be funny anymore.

John Isaacs moved from Berkeley to the Scripps Institution of Oceanography in 1948 from which vantage point he could involve himself wholly in all aspects of sea studies.

About that time he heard of the existence of huge freshwater icebergs in the Antarctic, some ten miles long and a mile wide, and set about thinking of ways these could be used to increase California's water supply. He thought they could be towed into the Peru current which would move them north to the equatorial currents, which would carry them westward and into the Kuro Siwa which would move them eastward towards Vancouver and eventually south along the California coast. The ice would take on a streamlined form as it moved; it would be powered by a temperature-difference engine; it would produce more water from rain than from ice melt. Eventually the berg would be parked behind Catalina Island. Somehow. The worst objection was that it would change the weather in southern California. In a year or so we found that this idea had been invented several times before but by then Isaacs had gone on to bigger schemes.

His curiosity about the animals that live in the depths led to the development (with Lewis Kidd) of the Isaacs-Kidd midwater trawl. This net had a hydrodynamic depressor across the bottom to hold it down while being towed at a depth of several hundred meters.

Isaacs was also keen on making photos of the animals that live on the deep-sea bottom. In the late 1960's in association with Richard Schwartzlose, Richard Shutts and others, he developed baited automatic cameras that were freely released in water as much as 7 km deep and recovered a day later. In several places he photographed a surprisingly large number of active invertebrates, fishes, and some gigantic sharks that changed man's thinking about the sparsity of life at depth. The nets and the cameras were extensions of his senses as he sought to find out: What's going on down there?

In 1958 he became head of the Marine Life Research Program concerned with discovering if man's overfishing or pollution had caused sardines to disappear from California waters in the early 1950's. His non-conventional approach was to examine (with Andrew Soutar) the yearly layers of undisturbed sediment layers in the Santa Barbara Basin contained the scales of fish species going back for some 1200 years. The result of counting scales, year by year, showed that sardines had, for natural reasons, come and gone many times before man arrived. This led to a rephrasing of the original question into: Why were sardines so plentiful when they were present? The answer is not yet known.

In 1950 I invented the deep taut-moored buoy and used it for wave measurements at the nuclear shots. The buoy was held about a hundred feet beneath the sea surface by a slender steel wire some 6,000 feet long that connected it to a heavy anchor clump installed on a sea-mount. This furnished a steady platform for instruments in deep water. John always wanted to "go me one better" and in 1966 he devised the "sky hook". It was a "taut-moored" earth satellite held just beyond synchronous orbit by a wire. If it could be built it would permit large amounts of material to be moved into space without the use of rockets. Aside from the problem of constructing this device, the wire into space required a tensile strength far beyond any known material. Someday it may be possible; in the meantime the idea has been duly credited in Arthur Clarke's book, "The Fountains of Paradise".

While thinking about how to deal with sea mines activated by a ship's pressure signal he devised a ship hull that trapped its own waves. This was basically an ordinary hull, sliced down the middle, the pieces transposed and separated with a closed bottom so that only straight sides were exposed. The propellor was between the hulls and ship carried a substantial breaking wave just inside the stern, the forward part being a raceway. I piloted a model of it thru many a test run without disturbing the surface of a glassy reservoir.

Later, Isaacs and Hugh Bradner proposed that the earth might be appreciably heated by neutrinos.

John Isaacs gave a good deal of thought to the matter of extracting power from the sea. In 1954 he studied the Claude thermal difference process and started to build a resonant wave pump for the end of Scripps pier. Later he reinvestigated tidal power schemes, pointing out that much of what seemed to be available head (usable water height) in an estuary would be lost as soon as any structure was built because the kinetic run-up would be much reduced.

In the 1970's he and various associates at the Institute of Marine Resources, including Walter Schmitt, Gerald Wick and David Castel, reexamined the utilization of energy from ocean waves. John liked to remind his listeners that more power is expended by waves in heaving (vertically moving) a ship up and down as it crosses the ocean than by the thrust of its screws. He noted that waves are a form of solar energy and that their very nature requires a great number of small devices be used if much energy is to be extracted. Their special feature is that if waves are cropped by some extraction device the wind builds them up again so that there could be a hundred times more power available than one observes in a steady-state condition.

Isaacs and associates established design criteria for wave powered machines and then proceeded to construct a wave-powered pump. A photo of a small version of this pump appeared on the cover of Science (Jan 18, 1980) spouting water some 18 meters into the air in waves only 0.6 meter high.

The advantages of zero fuel cost and only one moving part led him to suggest that a 50 kw plant of this type in trade-wind seas using a pipe 0.9 m in diameter and 153 m long would be very efficient -- if only there were a suitable application.

Next Isaacs (and Wick) looked into salinity gradient energy. This is a potentially large source of usable energy that can be tapped if the osmotic pressure between two fluids of different salinity can be harnessed. Where a stream flows into the ocean this pressure is equivalent to 240 m of head and more than 10 times that much if it flows into the Great Salt Lake. Several schemes for tapping salinity gradient were reviewed most of which required better and cheaper semipermeable membranes than are in existence. John pointed out that there may be greater amounts of energy available from the salt in salt domes than in the oil and gas that has been extracted from them.

At the end of the Isaacs paper on the forms of and prospects for using the.ocean for human power needs he concluded: "The most important --- will be in the employment of seawater for heat rejection and of the deep region below the sea floor for the disposal of nuclear wastes."

Isaacs, the whimsical philosopher, liked to consider the positions of events and energy in perpective. He and Walter Schmitt constructed an energy "ladder" and made order-of-magnitude estimates including some of the following:

Big bang	10^{75}
Sun's radiation (1 yr)	10^{41}
Ice age latent heat	-10^{33}
Marine biomass (1 yr)	10^{28}
Large salt dome	10^{26}
Largest H bomb	10^{24}
Tornado	10^{22}
Lightning flash	10^{17}
Human daily diet	10^{14}
Melting ice cube	-10^{9}
Striking typwriter key	10^{5}
Flea hop	10^{0}

Upon carefully considering the implications of the above he concluded (in Science) that the sun's radiation for one year could fuel the leap of 10^{41} fleas.

One invention was an elegantly simple means of controlling heat and moisture loss in divers, mountain climbers or others subjected to cold-dry stress. In normal breathing inhaled air is warmed and humidified as it moves towards the lungs; with exhalation most of that heat and moisture is lost. Under extreme conditions the heat-moisture losses are 250 times that at rest at room temperature. As Isaacs pointed out, by far the largest part of the heat lost is that required to vaporize water and divers/climbers have a serious problem of dehydration.

Previously existing techniques were complex, heavy and required some stored water. His solution was to equip the explorer with a small cylinder of hydrogen under high pressure.

The hydrogen is then pre-mixed with incoming air in a breathing mask and passed over a catylitic metal where it is combusted. This provides a supply of warm, moist air. As long as the amount of hydrogen is less than 3% there is no danger of explosion.

The patent for this device is held by the Foundation for Ocean Research. Isaacs' name does not appear on it but, as he liked to say, "There's no limit to what a man can accomplish if he doesn't care who gets the credit".

John Isaacs was committed to the conservation and protection of natural resources, but he was incensed by regulations that attempted to control the discharge of human wastes into the sea. "The return of organic waste and plant nutrients resulting from the most natural of acts to the sea is most probably beneficial. The benefits of putting the same material on land is clear to any farmer but the advantages to the sea are not so easily appreciated. The sea is <u>starved</u> for basic plant nutrients and it is a mystery to me why anyone should be concerned with their introduction into coastal seas in any quantity we can generate in the forseeable future." (Testimony of October 19, 1973). On other occasions Isaacs liked to note that if the human population of the southern California coast (about 10 million persons) were compared on a weight basis with the anchovy populations (then about 3.5 million tons) the anchovies would produce about 10 times as much fecal material. "Why should the human product be worse?" he would ask dramatically. "Don't you know that most sea animals live in a soup of fecal material and feed on it directly?"

John Isaacs was the chairman of the Scientific Consulting Board that guided the first decade of work done by the Southern California Coastal Water Research Project of which this writer is director. His wise guidance in the beginning established the attitude that has continued to this day. He felt strongly that we should try to understand the overall picture including all sources of contaminants against the background of changing sea conditions. The Project's contribution to man's knowledge of marine food webs, toxicity, and the understanding of marine biological processes, derives in part from John's intuitive suggestions.

One of John Isaacs more dramatic ideas was based on the six fold increase in the recorded incidence of tornadoes in the U.S. over the 40 years prior to 1975. He claimed that part of the increase was caused by streams of motor vehicles moving in opposite directions on highways and thus imparting angular momentum as a counter-clockwise torque to the atmosphere. He suggested that the center of tornado activity had steadily moved eastward in recent decades and that there were fewer tornadoes on Saturday when two-way truck and commuter traffic is at a minimum. Subsequent study by James Stork substantiated this forecast and showed specifically that there were, on the average, 300 less tornadoes per year on Saturday than other days.

Publication of this novel thesis in Nature created a storm of controversy at first but after extensive exchanges Isaacs' views seem to have prevailed. His position was that shear, caused by the flow of autos and trucks, is the largest identifiable source of non-random cyclonic vorticity. His analysis showed that rotating storms of the dimensions of hurricanes are energy-limited whereas those of tornadoes are limited by angular momentum.

Isaacs loved Beethovan, Brahms, Tschaikovsky, Mozart and Rimsky-Korsak; when he wrote or studied at home it was often to the accompanyment of great music.

In literature his tastes remained consistent throughout his life; the Bible, Shakespeare, Omar Khayyam, Mark Twain and Kipling were the leaders. He constantly quoted the first three, often used analogues to Mark Twain scenes (seeing himself as a latterday Huck Finn) and traded many a quote from Kipling with me. He was very fond of writing Omar quotes on blackboards or reciting them to students carefully noting which of the five editions was used.

In 1961 Isaacs became a full professor at the University of California, in 1971 he was made director of the University's statewide Institute of Marine Resources and in 1976 he was elected President of the Foundation for Ocean Research of San Diego.

John Isaacs was elected to the National Academy of Science in 1974,the National Academy of Engineering in 1977, the World Academy of Art and Sciences and was president of the Pacific Division of the American Association for the Advancement of Science. He was also involved with dozens of other clubs, societies, committees and chairmanships.

Among the tributes paid after his death were the naming of a research yacht after him (the RV John Isaacs), the annual award by the National College Sea Grant Program of the John D. Isaacs Memorial Scholarship for excellence in marine science by a high school student, and the John D. Isaacs Chair of Natural Philosophy at the University of California at San Diego.