Speaking of Weather...

From Polar Fronts to Solar Storms

The threat of the German zeppelin in World War I hastened the formation of the Naval Weather Service. It was apparent that the Allied Aviation Forces in Europe needed environmental support in order to combat this new threat. Thus, at the suggestion of the Commander, U.S. Naval Forces in Europe, initial steps were taken to form a special meteorological group to meet the needs of Naval Aviation. The requests for this service soon spread beyond those of aviation and, by war's end, the embryonic Naval Weather Service consisted of over 200 officers and men.

In 1919, the Naval Aerological Service was literally pigeon-holed in the Bureau of Navigation when the weathermen found themselves located in the Photography and Pigeon Section. After two years of molting with the bird people, the Naval Aerological Service was transferred to the newly formed Bureau of Aeronautics.

One of the key figures in the development of the Naval Weather Service was Francis W. Reichelderfer. As a naval officer and aviator, Reichelderfer was a triple threat man, qualified in balloons, dirigibles and multi-engine aircraft. As a meteorologist, he was a pioneer in developing aviation weather services and, from 1922 to 1928, supervised the reorganization of the Navy's weather service. It was during this period that he came across some research done by the Norwegian, Bjerknes. The Norwegian's theory, still valid today, dealt with the concept of air masses and frontal systems and observed that most "weather" occurs at the boundaries between large bodies of air which have differences of temperature and humidity. In 1925, Reichelderfer introduced the Norwegian papers on air mass analysis and techniques throughout the Navy's meteorological community. The concept has been important to the development of meteorology.

After many notable achievements, Cdr. Reichelderfer was transferred to the inactive list in 1938. He then became Chief of the Weather Bureau, a position which he held until 1963.

The Naval Weather Service's climb into space began on the wings of the 1917 airplane. Wing-mounted meteorological instruments provided a profile of the atmosphere through which the plane flew. By 1939, the balloon-borne radio transmitter, meteorological instrument package had become the routine method of obtaining upper air soundings. It is still used today. (Helium-filled balloons frequently attain altitudes in excess of 100,000 feet and provide information on the atmosphere.)

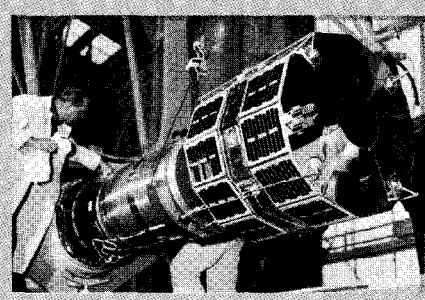
In 1954, a small group of Navy

SOLRAD

The problem of not receiving a routine radio broadcast may soon be resolved through the pioneer efforts of a dedicated group of Navy scientists and a satellite called *Solrad*. For those who have been denied hearing the opening game of the baseball or football season while making a Pacific or Atlantic transit, the aggravation becomes a personal thing. Operationally, it is a serious matter.

Most radio transmissions rely heavily on that electrified atmospheric shell, the ionosphere, which owes its existence to the influence of the sun on the various components of the atmosphere. Since the earth is not bathed in the same even flow of sunshine, there are variations in the levels and density of the ionosphere that surrounds it. These detached and sporadic layers of varied ionic composition are, in part, brought about by the disassociation of molecular oxygen and the heating of the atmosphere.

In general, the state of the ionosphere is sufficiently reliable to allow continuous communications, although radio frequencies employed have to be shifted. All this is true until some unknown triggers solar activity. The most common form of solar activity, the one that creates the greatest ionospheric disturbance, is the solar flare. Compared to hydrogen bomb explosions, the solar flare on the sun's surface is of such magnitude as to make man's effort appear minutely inconsequential. Photographs of solar flares depict flaming bases leaping hundreds of thousands of miles outward from the sun's surface. The energy involved exerts a great deal of influence on the earth's ionosphere and may be a serious hazard to man in space. Although Old Sol appears to be a benevolent and reliable orb that brings spring flowers and glowing summer tan, he can really be cantankerous at times.



Initially, the solar research conducted by Navy scientists of NRL was accomplished by the use of inter-

meteorologists joined with their colleagues from the Weather Bureau and Air Force to form the Joint Numerical Weather Prediction Unit at Suitland, Maryland. A year later, the group was routinely making operational computer forecasts. In 1959, the Navy established the Fleet Numerical Weather Central at Monterey, California, to support fleet meteorological and oceanographic needs.

To support the environmental service needs of the forces' effort, data from ships at sea and island and land stations are used. In addition, Navy aircraft are used for meteorological and oceanographic observations. The VW-l *Typhoon Trackers* and the VW-4 *Hurricane Hunters* of the Pacific and Atlantic, respectively, fly the tropical storm watch.

However, the Navy's need for new and sophisticated weaponry and support of naval communications will force the Naval Weather Service to extend beyond the fringes of the earth's atmosphere. With satellites and other space traveling vehicles, the need for space weather reports is becoming as important as routine ship weather forecasts. Over the past two decades, man has learned much about space environment, but the focal point of space environment is the sun.

The sun is not just a quiet, orange ball that rises in the east and sets in the west. Frequent storms rage across it, spraying large volumes of gas, and electric energy fields, into space. Fortunately, not all the blasts from these storms strike the earth. But when they do they cause all kinds of communications' blackouts. This happens because most radio systems depend upon the electrified blanket, the ionosphere, that surrounds the earth at an altitude of 60 to 300 miles. When a solar magnetic storm is taking place, the increased electrical flow from the sun to the earth overcharges the ionosphere and can light up the polar regions like a neon tube — the aurora borealis.

In mid-1973, the Naval Weather Service will make a quantum jump into space when *Solrad-Hi* will be launched on a *Titan. Solrad,* a contraction of solar radiation, is a sun monitoring system made up of three 24 x 30-inch satellites that will be placed in a circular orbit at an altitude equal to 20 earth diameters. The satellites are being fabricated by Navy scientists at NRL. *Solrad-Hi* is also the first solar satellite system able to continuously monitor the sun and have a real-time readout capability.

In order to make use of these observations of the sun, the researchers at NRL and the Naval Weapons Center, Corona, California, are in the process of developing techniques to forecast the sun's activity and its influence on Navy communications. Once these prediction methods are established and translated into computer programs, the Naval Weather Service will begin providing this information on a routine basis. It is presently planned to issue these forecasts from the Fleet Weather Facility at Suitland.

As man becomes more sophisticated, so do his military systems. The problems of space environment forecasting will be staggeringly difficult, but then, so are those of air masses and fronts.

— *LCDR. NEIL F. O'CONNOR*

mittent rocket probes and by monitoring with ground-based sounders. The advent of satellites, however, added a new dimension to the research effort and has made possible the measurement of many additional parameters. Satellites have greatly enhanced the progress of NRL's solar research, which began in 1949. For the past decade, the Navy has been operating satellites on the fringes of outer space. The satellites used for monitoring solar radiation are *Solrads.* The first SR-1 was launched in June 1960 and has been followed each year by an improved model fabricated by NRL scientists. The Navy's *Solrad* program, with its single U.S.-based ground station, is recognized by the Department of Defense as an example of a space science effort which has high operational utility. Unlike other satellites that have multi-purpose space functions, *Solrad's* principal mission is to monitor all aspects of the sun's activity.

Operation of the *Solrad* system epitomizes cost effectiveness. Telemetered data from the satellite are received at the NRL Tracking and Data Acquisition Facility at Blossom Point, Maryland, where they are relayed by dataphone to the Solrad Data Operations Center, at NRL near Washington, D.C. The stored digital telemetry data are then converted into operationally useful message formats and transmitted to many users. The Naval Communications Command utilizes the data in formulations of Navy alerts to all communicators. Outside the Navy, *Solrad* data are furnished on a routine basis to the Environmental Services Space Disturbance Forecast Center at Boulder, Colorado, and the USAF Solar Forecast Center on Cheyenne Mountain, Colorado.

Future plans call for continued development of forecasting models and techniques and for placing three small solar monitoring satellites in an orbit at an altitude of 20 earth radii (about 70,000 nautical miles). At this altitude and with extended deployment of the three monitoring devices, continuous coverage of solar activity will make real-time continuous transmission of data to the single existing ground station a reality. Forecasts of solar activity are expected to be as readily available as daily forecasts of weather. It is expected that the Naval Weather Service, with its worldwide centers and computer facilities, will be responsible for the dissemination and interpretation of the forecasts for Navy users. Armed with this information, the communicator will be able to select those radio frequencies which will allow him to best avoid solar interference. Thus, the day of the lost broadcast may soon come to an abrupt halt, thanks to the efforts of NRL scientists.

LCdr. O'Connor is a frequent contributing editor to Naval Aviation News.

ROCKET POLITICS

and Robert F. Freitag

Photograph by JOC James Johnston


U.S. NAVY
POLARIS

Captain Robert F. Freitag, USN (Ret.), is probably the only officer in the Navy to be awarded the Legion of Merit for being a salesman.

This man, Admiral Connolly emphatically states, was a tremendous motivator. "He was cited for being that one person in the Navy most responsible for bringing the *Polaris* concept into an approved status so that the program could be set up and started. Bob Freitag was a personal crusader — a real stem-winder. He devoted his entire career to the furtherment of rocketry and missilery and was the chief stimulator of not only *Polaris* but also the Pacific Missile Range and the Navy's space programs."

Freitag never had a day of sea duty. He was neither inventor nor pioneer. He did not wear the wings of a Naval Aviator but most of his assignments were in the Bureau of Aeronautics. Paradoxically, as a middle grade officer, he moved in high level, senior Navy and national circles, exerting a profound influence. How this was accomplished, largely in the complex environs of Washington, is best answered by the man himself.

ROCKET POLITICS- *and Robert F. Freitag*

Bob Freitag speaks softly, with economy of words. "Let me explain," he says, "the background of the ballistic missile program; it has a direct relation to the present space program. Without one, the Navy wouldn't have the other."

Polaris was an outgrowth, Freitag points out, of our post-World War II interest in missile weaponry. How he became involved was pretty much by accident. As a youngster, Lindbergh's solo flight across the Atlantic had stimulated his desire for a career in aviation. But with prospects of higher monetary return, he accepted advice that he should take engineering law in college. Then, threatened with the pre-war draft, he switched to aeronautical engineering, an immune curriculum which would enable him to complete his studies. It wasn't easy; because of his part-time job managing a soda fountain, it took him more than five years to earn his degree at the University of Michigan. But just prior to graduation in 1941, he was approached by Captain Lyle Davidson, an enterprising naval officer who was making his own personal effort to recruit promising, upcoming engineers for the Navy. Although Freitag's grades were not the best, the captain offered him an ensign's commission and postgraduate work at the Massachusetts Institute of Technology — an attractive inducement, especially since the young man had recently married.

The aeronautical engineering program did not involve pilot training but, thinking beyond his first desire, which was to fly, Freitag applied himself assiduously to his studies at MIT. Imbued with a feeling of responsibility toward the Navy, he was at the top of his seven-day-a-week Navy class. His reputation for superior performance as an engineer reached new proportions after he was assigned to BuAer as an aerodynamicist. Throughout the war years he was consistently rated by his superiors as "outstanding" and "the finest engineer they had ever worked with."

Upon the cessation of hostilities, Freitag was faced with the problem of choosing a career. Either he could stay in the Navy with the inevitability of having to go to sea periodically; or he could go into industry and concentrate solely on engineering. Being of a practical nature, he decided to accept a job as Chief of Aerodynamics for Aero-Products Propellers.

The postwar Navy was also aware of the value of specialization in certain fields. Thus, when the AEDO (Aeronautical Engineering Duty Only) program was initiated, he quickly returned to active duty where his first assignment was to join the Naval Technical Mission in Europe.

Early in 1945, the Joint Chiefs of Staff had ordered forces in Europe to preserve and take under control "records, plans, documents, papers, files and scientific, industrial and other information and data belonging to . . . German organizations engaged in military research." An immense collection process was soon underway, with particular emphasis on rocket and missile technology. Along with tons of reports, documents, data and notes, Allied forces gathered up nearly 100 V-2's, complete with production machinery and associated equipment. They also managed to dismantle a huge supersonic wind tunnel which was then shipped to the Naval Ordance Laboratory in Maryland for use in rocket development. General Dornberger, von Braun and the leading rocket technologists of Germany voluntarily turned themselves over to the Americans in Austria.

The job of the Naval Technical Mission in Europe was to sift out what might be useful to the United States. In that capacity, Freitag was primarily interested in supersonic wind tunnels, but he had also been tasked to interview the German rocket people. It was an opportunity for enlightenment. By the time he returned home, LCdr. Freitag was not only an expert on guided missiles but he had also decided to devote his energy to their future naval development.

As Assistant to the Director of the Guided Missile

Division, in 1948, he planned the Navy's experimental work with the captured German equipment and the guided missile programs which included *Viking* and *Aerobee,* an evolution which would progress into the *Sparrow, Rigel* and *Regulus* weapons.

"During this 1948-1949 period," says Freitag, "while on another assignment to Europe, I became deeply involved with a joint Army, Navy, Air Force effort — coordinated with the British — to evaluate the Soviet missile program. It soon became apparent to me that the Soviets were going like the devil on *ballistic* missile development. While we in this country were doing almost nothing along those lines. My interest expanded very rapidly beyond the 'pilotless aircraft' concept, which had been our main concern, to the idea of selling ballistic missiles to the Navy.

"The first thing to be done was to take what we had — the relatively small NRL *Viking* — and see if we could make a weapon version of it. By 1952, it looked pretty promising. Meanwhile, I had a tour of duty at Cape Canaveral where I became even more convinced that ballistic missiles were in our future. It was during this tour at Cape Canaveral in 1951 that I first became acquainted with Wernher von Braun when the Army missile team launched the *Bumper Rocket,* a V-2 modified by adding a second stage WAC rocket. So, upon my return to Washington, I got myself assigned to the surface-launched missile branch, and it was there that I began to work with Captain Grayson Merrill and Bob Truax. I had known them both over the years but this was the first time we were actually able to work together."

In 1953, Freitag's primary assignment was "to look after the *Regulus* program." Truax was working on advanced planning for future missilery. Both men, along with Capt. Merrill and NRL's Milt Rosen, were convinced of the superior potential of the ballistic missile. The weapon version of the *Viking* had been turned down eventually in favor of smaller missiles, but the *Viking* had at least demonstrated the feasibility of successful launches from the rolling deck of a ship at sea, as well as many of the very advanced techniques of rocketry required for ballistic weapons such as gimbaled rocket engines for control and guidance, a separable nose cone for payload development and lightweight, efficient structures. Many of the very early techniques of today's space systems originated in the early *Viking* research, including much instrumentation, payload design and space photography. As far back as 1947, Truax had submitted a paper on surface-launched missiles; now he was trying to convince people that ballistic missiles could be fired from the sea itself.

The *Regulus* was an air-breathing pilotless aircraft and, although Freitag was able to guide the program to a successful conclusion, including deployment of operational missiles aboard aircraft carriers, cruisers and submarines, there were obvious drawbacks to its combat potential. Truax, meanwhile, prepared a new study entitled "A Means for Making the Guided Missile Submarine a Primary Naval Weapon," which pointed up the shortcomings of the thinking at that time.

The original plan for *Regulus* involved the use of three submarines for two missiles — one which surfaced and launched the *Regulus* missiles while the other two provided radio guidance. Within the *Regulus* program, an advanced inertial guidance system was under development which eliminated the need for the two guidance submarines and provided greater security by eliminating the need for radio transmission that could be intercepted or jammed. Still, both Truax and Freitag reasoned, a much greater improvement could be achieved by utilizing ballistic missiles which could be launched under water to avoid detection of the launching submarine and which could fly at extreme altitudes and hypersonic speeds and prevent interception by active defenses.

"During the war," Truax states, "the Germans had proposed a towed submersible barge from which a V-2 would be launched. It was a very cumbersome thing — with liquid oxygen, only one missile per sub, and it had to be towed around. It was very unhandy. As bad as the *Regulus.* What was needed was an increase in the ratio of warhead payload to submarine weight. The ballistic rocket was the answer. It is very dense — a pressure vessel that can be exposed to sea pressure without a lot of protection. You could plaster the missiles — a great many of them — all along the outside of the submarine. Once released from the side of the sub, a missile would rise to the surface, much like a buoy, and from there it could be fired on command. You would have a tremendous increase in payload, secret mobility, and economy (because no elaborate launch pads or facilities were required). The disadvantage was a reduction of submarine speed as long as the missiles were attached."

And, as Truax puts it, "At that time, just the *idea* of putting a missile on a submarine — let alone the notion of putting a nuclear warhead on an underwater missile —

was considered pretty kooky! We didn't get very far with it."

By 1954, while the Air Force was moving ahead with its ICBM's and the Army was developing its *Redstone,* the Navy was engaged in an internal *reappraisal* regarding the proper role of the missile in naval operations. In a complete turnabout from the earlier period, BuOrd was advocating a winged missile (pilotless aircraft), known as *Triton,* while BuAer was thinking in terms of ballistic trajectory rockets, a somewhat paradoxical reversal of their traditional experience and roles. Some officers questioned the assignment of missile priorities in view of the state of the art and budgetary considerations, while others called for a diversified research and development program with emphasis on the ballistic type missile.

It was in this unsettled atmosphere that Cdr. Freitag and a civilian BuAer scientist, Abraham Hyatt, decided to take the initiative. "We knew the Russians were moving real fast," states Freitag. "So we looked at all the different efforts that were going on and put them together in a study for a ship-launched ballistic missile. There were three key men who gave us tremendous support throughout this episode. They were Rear Admiral Bill Schoech, chief of R&D in BuAer; Captain A. B. Metsger, head of the Guided Missiles Division; and Rear Admiral Jim Russell, Chief of BuAer — who later really put his career on the line for this operation.

"The study was completed in late 1954 at just about the time that the presidential committee on weapons systems, chaired by Dr. James Killian, president of MIT, came out with a major recommendation that ballistic missiles be developed: ICBM's — IRBM's — and (almost as an afterthought) sea-launched missiles. Commander Pete Aurand was involved with the Killian Committee and it was because of his efforts that the policy statement included *that* final item. As a result, for the first time we were able to start getting the attention of key Department of Defense and Navy personnel."

The fleet ballistic missile (FBM) enthusiasts in the Navy did not have easy sailing, even on their own waters. While launchings from cargo (or "Q") ships were practical, *submarine* operation was the elusive goal. Ballistic missiles of the time were either of short range or would prove too large (100 feet long) for easy handling aboard a submarine. Then, too, there was the question of who would have cognizance of the program, BuOrd or BuAer? The Killian Committee had lent support to the Freitag/Hyatt study, but not until there was an improved degree of miniaturization in electronics could there be a viable FBM system. Needed, too, was a solid propellant of sufficient specific impulse. None was in existence; nor was there a suitable navigational system, an accurate guidance system or an acceptable fire-control system. It was argued, logically, and with good cause, that the FBM would be a continuous drain on Navy funds — to the great detriment of other equally important programs. Therefore, in July of 1955, BuAer was ordered to cease and desist in the matter of the FBM.

Nevertheless, the gears of the Freitag/Hyatt motor were already meshing. Letters had previously been sent out to 22 aerospace contractors and laboratories requesting ideas on solutions to the myriad problems of launching a 1,500-mile rocket from a submarine beneath the surface of the sea — a rocket with a nuclear warhead that would strike an 'inland target with pinpoint accuracy. Detailed design proposals were soon forthcoming, not only from industry but also from NRL, the Naval Air Missile Test Center, the Army Redstone Arsenal and the Naval Ordnance Test Station. The FBM program, they said, *was feasible.*

JOC James Johnston

"Then a fortuitous thing happened," says Freitag. "Admiral Russell and Captain Tom Moorer* had already convinced the Assistant Secretary of the Navy for Air, James H. Smith, of the importance of the FBM, and they apprised him of its controversial nature. So, when Admiral Burke was named to take the reins as the Chief of Naval Operations, former Naval Aviator Smith immediately briefed him on the problem. The first thing Admiral Burke did was rescind the order which had restricted BuAer's work on the FBM. As I recall, he was sworn in on a Friday and on Sunday Russell and Metsger were already going over the plan with him. Then he just said, 'Go! Full speed!' and he told BuAer to get the thing sold — internally and externally."

Freitag, who had by now established the firm base of practicality rather than conjecture and who had successfully enlisted the necessary support of his own organization, embarked upon a selling campaign aimed at convincing those outside the Navy. Of particular significance was the strong support Freitag had enlisted in the Bureau of Ships. There, under the leadership of Commander "Red" McQuilkain, feasibility studies of ballistic missile launch ships and submarines as well as ship navigation and fire-control systems were evolved which further reinforced the feasibility of the concept. "Once Admiral Burke had said 'Go,' there was no more conflict between BuAer and BuOrd. It was 'all shoulders to the wheel,' and we worked like hell.

*Admiral Thomas H. Moorer is now Chairman of the Joint Chiefs of Staff.

"But, at about that time, a tentative Defense Department decision was made in response to the Killian report: The Air Force would develop ICBM's (5,000-mile range); both the Air Force and the Army would develop IRBM's (1,500-mile range) — the Air Force would be prime and the Army would be back-up. Navy was out!

"The factor was that the Navy had just been given the satellite project, *Vanguard*, an endeaver believed to have tied up all of Navy's capability — we were presumed to be too busy developing *Vanguard* to have anything to do with an IRBM. The Army was kept in business because, with von Braun's team at Huntsville, they had a *capability* (although no real requirement). In essence, the Air Force appeared to have the ballistic missile market cornered."

Curiously, the DOD decision did recognize the validity of the Navy's *requirement* for the FBM — which was a form of IRBM. The door was still open and Bob Freitag rushed through — all the way to Huntsville where he spent three days with his old acquaintance, Dr. von Braun.

"I proposed to von Braun," states Freitag, "a very simple proposition. He could see that the Navy requirement made a lot of sense. We knew the United States wouldn't be able to stay in Turkey and Italy and other places forever with our rocket weapons — we were just drawing fire to those countries. But if we put the launch platforms *at sea*, we would still have all the advantages. So, I suggested that he redesign his missile for shipboard operation, which in essence meant putting a fourth gimbal on the guidance platform to take care of pitch and roll. We (Navy) would take care of shipboard installation — all the fire control – but he (Army) would have the rocket. In effect, with his brains and our good looks — our *requirement* and his *capability* — we would have something we could work with."

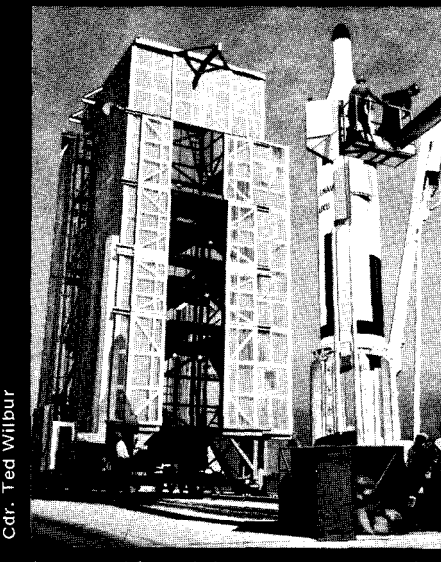
The Navy had been working with von Braun for a few years. Commander Hoover had generated enthusiam for Project *Orbiter* prior to the *Vanguard* decision. "*Orbiter,*" says Freitag, "was essentially the *Explorer*, which was finally launched two years later. It was a matter of taking a *Redstone* and putting more stages on it.

"Well, von Braun accepted. He said, 'I will support it and take it through Army channels and you can take it through Navy channels.' Then, when I got back to Washington, Admiral Russell said, 'Fine,' and it went on up the line."

Somewhat to the surprise of the Pentagon, the Army and the Navy had formed an alliance for a fleet ballistic missile. In effect, the Department of Defense was confronted with a counterproposal to its directive. Two of the services had planned a logical *joint* ballistic missile program. Under the circumstances it was difficult to say no. The *Polaris* program was underway.

POLARIS DEVELOPMENT

The development of *Polaris* (which had first been named *Thor* – no relation to the Air Force missile) is a separate story in itself. The original Army/Navy concept actually was to be a modified *Jupiter*. Its size (58 feet in length) and the fact that its lower stage utilized cryogenic propellants (both features being undesirable), prompted the Navy's Special Projects office to investigate the potential of less volatile fuels. The ultimate Navy goal remained one of underwater launch from submarines and



Cdr. Ted Wilbur

the storable solids were most conducive to success in this regard. Size remained a problem, and size of the rocket was dictated by the warhead weight and propellant efficiency. A bold gamble that warhead weights could be dramatically reduced during the *Polaris* development lifetime needed to be taken to fully exploit the FBM potential. With the support of Dr. Edward Teller and others of the Atomic Energy Commission this gamble was taken. As a consequence, not only did the eventual breakthrough on solid propellants and smaller warheads* permit a much smaller missile (the *Polaris A-1* was about 28 feet), but it also brought about the dissolution of the Army-Navy partnership which had served the basic purpose of getting the initial FBM approval.

*It was the reduction in warhead size that permitted the lower performing solids to be used. The performance of solids was later improved so that payload/weight ratio approached that of liquids. Today, solid rockets are heavier than their liquid counterparts.

During the early development period, Commander Freitag stayed on in the Office of the Chief of Naval Operations, "just across the street" from BuAer, where he helped with the organization of the *Polaris* program. A nationwide industry team was called in. Top management attention was secured and many industrial contractors (in addition to those in the Navy and NRL) were welded together in a cohesive team. "It was through this fantastic type of operation," says Freitag, "that I came to know the right people — the ones who would prove to be so helpful later on."

A POLARIS MAN

Captain Roger Boh, then a lieutenant commander, was a Naval Aviator assigned to Polaris as a test conductor at Cape Canaveral under missileer K.C. "Casey" Childers (now Naval Air Systems Command Representative, Atlantic). A fighter pilot and engineer, Boh applied his talents to development of the spectacular weapon at a time when there was much White House interest. "At the time of a launch, I don't imagine my feelings were much different from Alan Shepard's when he was sitting on top of the Mercury/Redstone. The first five shots were failures. One went straight up and came straight down. Two blew up on the pad, and a second stage missed us by one-fourth mile. Lots of snakes came out of the bushes." Capt Boh is now assigned to F-4 project office.

JOC JAMES JOHNSTON

With one arm up to the shoulder blade in *Polaris,* he then busied the other by stirring the pot wherein the space stew simmered — and *applications* bubbled. Fifteen years of experience in the ways of the Navy — and, for that matter, the Army, Air Force and industry — came to the fore as Freitag set his sights on space. Long ago he had learned the few basic rules of making progress in an organization: dedication (with humor); understanding (especially of the opposition); and flexibility. (There is more than one way to get aboard. If you think about it, it doesn't always have to be a *left-hand* pattern....) Now, he was rapidly becoming a virtuoso of the art, and *variety* was the keynote of his repertoire. As he maneuvered from individual to group to committee, he employed all manner of tactics, subtle, direct and circumventive — but he never lost sight of his goal: the U. S. Navy in space.

For Step Two of the master plan, he advanced the idea of building up the Missile Test Center at Point Mugu as a counterpart of the Atlantic Missile Range. "The idea of having a Pacific Missile Range (PMR) was, first, to have a targeting area for ICBM's and IRBM's, and also to have a launching base for polar orbiting *satellites.* At that time, it was believed that Cape Canaveral was unsuitable for certain satellite vehicles because of safety problems; the falling stages would represent a danger.*

"The planning operation," Bob Freitag recalls, "put me right on the Army circuit, the Air Force circuit and the then-new NASA circuit. During that entire course of time (approximately two years) I made over 200 presentations — up and down every hall, in and out of offices, stopping people in passageways, doing everything I could think of — just trying to make this thing go.

"Because of this perseverance, we were able to convince the Secretary of Defense that we had to have a range on the West Coast to do the training and also the operations. What I am speaking of here was a long drawn-out series of Department of Defense reviews. A team had been formed of Army, Navy, Air Force and DOD people for the purpose of inspecting all facilities for missile operations — and even aircraft flight testing — in order to determine what the optimum range configuration should be. This committee, which was called the Special Committee on Adequacy of Range Facilities, finally recommended: a West Coast range (PMR) which would be basically under the Navy; the mid-continent land range at White Sands, which consolidated the White Sands/ Alamogordo area into one good range; and the East Coast range under the Air Force."

According to Cdr. Freitag's thinking, especially during the 1957-1959 period — after the Russians had launched their *Sputniks* and *Explorer* had been so successful, and then, of course, the Navy had its *Vanguard* — it was time that consideration be given to satellites from an operational standpoint. "There were items coming along such as *Transit, SynCom* and *Tiros,* weather satellites and so forth, but it seemed as though the Navy always ended up working for someone else. *Vanguard* was working for the IGY; and *Transit,* which was generated by the Navy/Johns Hopkins Applied Physics Lab, was being run by the Advanced Research Projects Agency (ARPA) group.

"There were also," Freitag reflects, "many people within the Navy who were content with that situation. Fortunately, Tom Connolly was on the scene, as assistant for plans to the Chief of BuAer. I had known him back during World War II when he was a VP (flying boat) pilot and then at Flight Test at Patuxent River and, of course, later at TPT (Test Pilot Training), but now I had the opportunity to work directly with him. Because of his position, I knew that he was the best man to convince that the business of testing at PMR was not only important for our flight test aspirations — but that it was also probably going to provide a real opportunity for space.

"He spent a lot of time looking over my proposition and finally agreed with it. In order to give it proper focus, I

*It is still true.

recommended a plan that ultimatelv resulted in what is now known as the Connolly Report. Admiral Russell, who was then Vice Chief of Naval Operations, also gave his support. I had explained to him that the same sort of ingredients existed in the space question of that year (1959) as had existed in 1955 with ballistic missiles."

Freitag pointed out to Admiral Russell the need to educate all the appropriate offices at the same time: OpNav, BuShips, ONR (Office of Naval Research), practically everyone in the Washington Navy. "We had to get the really good key people together; otherwise, we would be forever trying to get off top dead center."

Admiral Russell bought it; Freitag was told to write up the charter. Two days later, with Admiral Burke's blessing, Russell signed it.

Captain Thomas F. Connolly was named chairman of the 1959 *ad hoc* committee on astronautics. Members of the twenty-man board included, along with Freitag, Truax and Berg, representatives of various key divisions of OpNav, BuShips, BuOrd, BuAer, BuMed, ONR, NRL and PMR. Not only did the group examine what was going on in space and sort out what was important, but they "equated their findings with Navy requirements and set up a program that made sense. In addition, they recommended an organization to execute it.

"It was a rather comprehensive job. Two new sections were established in CNO: OP-54, which was under Admiral Pirie, DCNO(Air), and looked after things like PMR; and OP-76, an office truly responsible for space matters, which is still with us today. And, near the end of the year when BuAer and BuOrd merged to form the Bureau of Weapons (BuWeps), an astronautics division was established to parallel the aircraft division. The Navy was ready to play an integral part in the development and fulfillment of the national effort and particularly of the military space programs.

"However," Freitag continues, "the biggest problem came along in 1961 when, again, the Navy was almost put out of business as far as space was concerned. In that year, a directive was issued which said in effect that the Air Force was to be, with a few minor exceptions, the sole agent for all space programs. If the Navy was to stay in the game, we would have to work through the USAF.

"Well, in the long run, we were able to make this procedure work. In some respects it was a blessing in disguise. For instance, I was among those who at one time were in favor of adding another stage to *Polaris* and making it a launch vehicle. The idea was to create a device for reconnaissance — bomb damage assessment, and so forth – that would be launched from the sea, make one orbit and be recovered. It was a pretty advanced proposal; we called it *Sea Scout.*

"Although it was a good idea," says Freitag, "it probably would have sopped up all the money the Navy had, if we had gotten approval. But, of course, due to the directive we couldn't get it. Instead, we put all our money into payloads — scientific instruments and satellites — and, to get them up there, we used Air Force boosters, which they furnished. It worked out very nicely. A highly effective program

"In retrospect, I often think back to those days of 1955 when we were trying to sell *Polaris,* and one of the big objections was the problem of pinpoint navigation. There were those who said it just couldn't be done. Yet, it was only five years later that an earth satellite, *Transit,* was tested as a navigational system — and the following year it was operational. In only five short years we were using a system that was a hundred times more accurate than anything that had ever been done before. But, back in 1955, there were people who could not even *conceive* of a satellite.

"Well," understates Freitag, "we educated them."

Captain Bob Freitag may have been a "mover behind the scenes," largely unrecognized by the public and the general naval community, but he left a lasting mark on the Navy's future in space. By 1963, practically every Navy space project bore his brand — PMR, *Transit, SpaSur* and ANNA among them. His Operation *Starlight* was an amplification of the Connolly report, but with emphasis on the future ten to twenty years. In his many writings and lectures (some said when the first man would step on the moon, Freitag would be there delivering the speech), he emphasized two points: the value of astronautics and the future outlook for the Navy. The value, he pointed out, often comes from explorative research. "What is experimental today, may become essential tomorrow. In the beginning, there were few who could see the potential of a satellite, just as today there are those who question the exploration of the moon and planets. But the new technology enriches life in this world and makes it easier for us."

The basic programs which he planned, prodded, pushed, organized and guided still form the nucleus of today's astronautic Navy: communications, surveillance, weather, geodesy, navigation — and support.

And what of Bob Freitag? In 1963, after 22 years of active duty, he retired from the Navy. It had become obvious that, as a captain, he had reached the highest plateau in his own promotion structure. His particular talents had been devoted more toward innovation and pathfinding than to the acquisition of *command* experience. To the man who had been called "Mister Astronautics of the Navy," Admiral Connolly gave counsel: "Through the years you have been with us, you have given a direction and impetus which has been invaluable. You have done here what had to be done. Now, it is time you devote your energies to the civilian space program where your capabilities can reach their full potential."

Thus, since 1964, Captain Robert F. Freitag, USN (Ret.), has been Director, Manned Space Flight Field Center Development for NASA. Among his responsibilities — which include liaison with Congress — has been the Manned Space Flight Center at Houston.

Ask Bob Freitag what all this means in the infinite scheme of things and he will probably smile and quietly say, "What good is a newborn baby?"