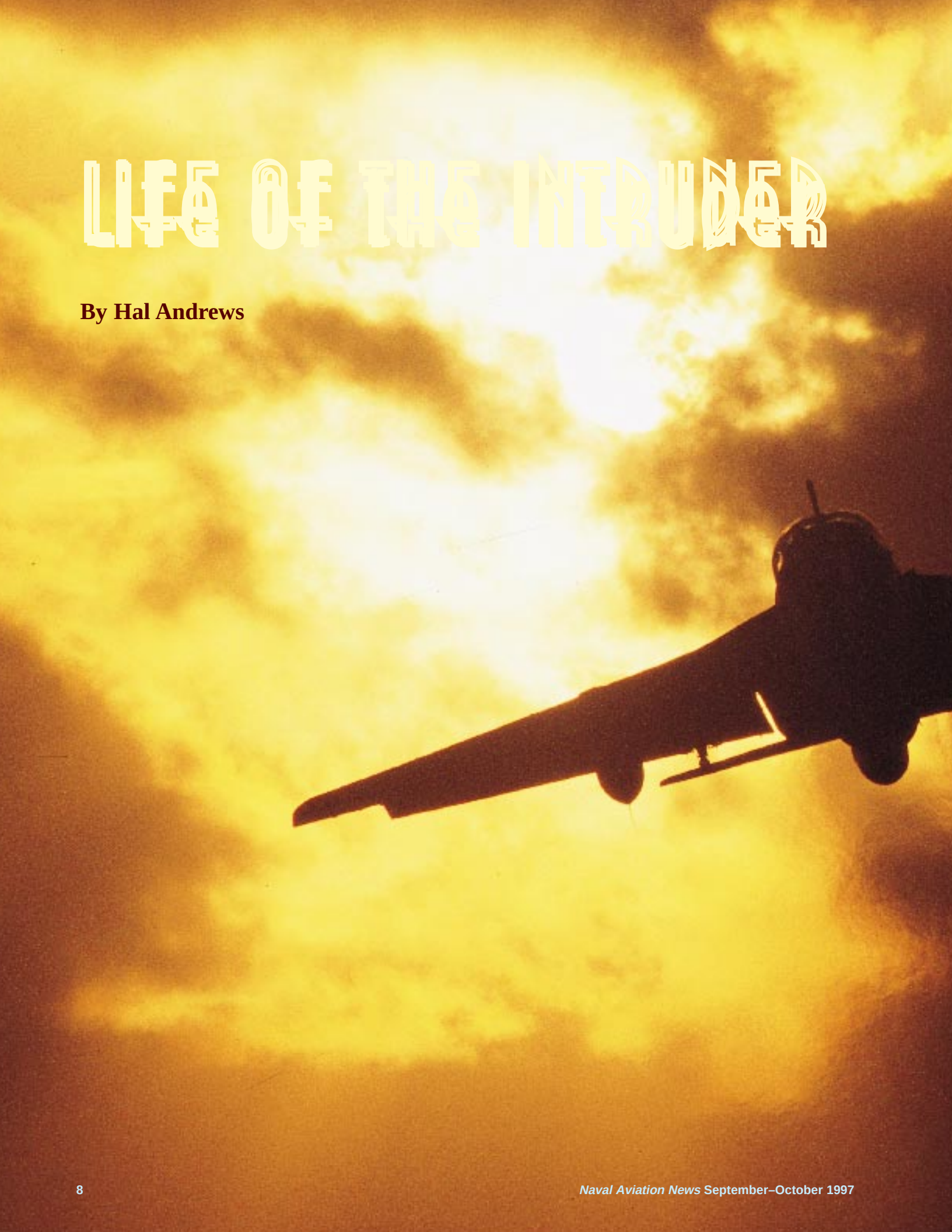
LIFE OF THE INTRUDER

By Hal Andrews



The Grumman A-6 *Intruder* could never have won a beauty contest. With its engines and exhaust nozzles at mid-fuselage instead of at the rear end, an ample cockpit canopy over the crew and a bulbous radome nose, it was often described as being pointed at the wrong end. But if a warplane should sport aggressive lines, especially when carrying its lethal weapons, the *Intruder* measured up with a beauty all its own.

The old adage "form follows function" is appropriate in the *Intruder's* case. The Deputy Chief of Naval Operations (Air Warfare) staff, the Bureau of Aeronautics (BUAER) personnel who prepared the type specification for the airplane's design, and the Grumman team who put together the winning proposal all played a part in creating a configuration that remained almost unchanged through 30 years of production. Extensive internal changes and replacement of the original wings with new composite construction made little difference in the basic external appearance—once some initial design quirks were ironed out. Even its direct descendant, the EA-6B *Prowler,* closely reflects its *Intruder* roots. Looking back today after the A-6's premature retirement, its designers can be content; the plane more than met the farsighted Navy and Marine Corps requirements of 40 years ago that brought it into existence.

Beginnings

The Navy's Korean War experience, with no jet all-weather strike capability and limited carrier air group night or all-weather effectiveness, prompted research on avionics systems to overcome this deficiency. By the mid-1950s, the Marine Corps defined its need for an all-weather close support airplane capable of operating from the shortest possible expeditionary field runways.

Meanwhile, the Navy was introducing the first of a new generation of jet carrier aircraft. These ranged from the smallest attack jet—the A4D (A-4) *Skyhawk*—through various fighters, to the long-range, heavy attack A3D (A-3) *Skywarrior.*

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Unpainted and flown gear down, the *Intruder's* first flight photos emphasized the awkward appearance of the Navy's latest jet, especially compared to other tactical and commercial jet aircraft of the day.

Both of these attack types were designed for nuclear strike missions, as well as being capable of delivering conventional ordnance. However, their limitations—including no all-weather attack systems in the A4D and the adverse impact of the A3D's large size in carrier operations—led to studies showing that the application of new avionics technology could produce a carrier-based, all-weather attack aircraft capable of long-range conventional or nuclear strike missions flown at low terrain clearance altitudes, below radar interception. The complex avionics would require a second crewman for its effective use.

An operational requirement was established by the office of the Chief of Naval Operations in 1956 for an all-weather tactical airplane, combining the carrier attack mission with the Marines' close-support, short-field capability. Early in 1957, BUAER set forth the demanding mission and operating performance requirements, along with appropriate current design features, such as ejection seats for the aircrew. With range and short-field/carrier takeoff and landing requirements, either jet or turboprop engines would be acceptable in the design. Typically, various system components and equipment, such as the engines, would be Navy procured and furnished and the proposed contract would require the winning contractor to be responsible for the totally integrated "weapon system." Eight companies submitted 11 designs, ranging from turboprop-powered designs to a supersonic jet and a vertical/short takeoff and landing airplane.

Grumman's proposal was selected in December 1957, with contract go-ahead for the now designated A2F-1 early in 1958. A unique feature of Grumman's design that played a role in its selection was tilting exhaust nozzles on the mid-fuselage J52 engines. These exhaust outlets angled down 23 degrees for short-field or carrier take-offs and landings without producing undesirable pitching moments.

Initial design and wind tunnel testing led to the mockup inspection in September 1958. Many changes in design details would follow, but the overall airframe configuration was well established. Development and construction of initial aircraft was contracted in April 1959. The first aircraft (BuNo 147864) was rolled out in early 1960 and after ground testing at Bethpage, N.Y., was transported to Calverton, N.Y., for its first flight in April.

As flight testing proceeded, various changes—several of which fortunately improved the *Intruder's* overall appearance—were made. The tilting exhaust nozzles didn't give enough improvement to justify their weight, complexity and cost and were eventually replaced with straight tail pipes. The vertical tail shape was changed to correct predicted marginal spin recovery characteristics, and the horizontal stabilizer was revised to a slab which was moved aft to correct a hinge moment problem without redesigning the fuselage attachment components. The speed brakes were perforated to reduce buffeting and supplemented with wing tip brakes for adequate dive-bombing effectiveness. Later, the familiar fixed centerline in-flight refueling probe in front of the windshield was added.

While airframe characteristics, including those of the new nose gear tow catapulting system, were worked out, the new avionics systems were a different story. Not only were there difficulties with individual components, but the Digital Integrated Attack and Navigation Electronics (DIANE) system was almost unworkable and the unreliability of the components was multiplied in the full system. A combined Grumman–Navy effort to redesign components gradually brought hope of a system capable of use for normal flight and led to solutions for its attack mode problems. Meanwhile, the A2F-1 became the A-6A in 1962 designations.

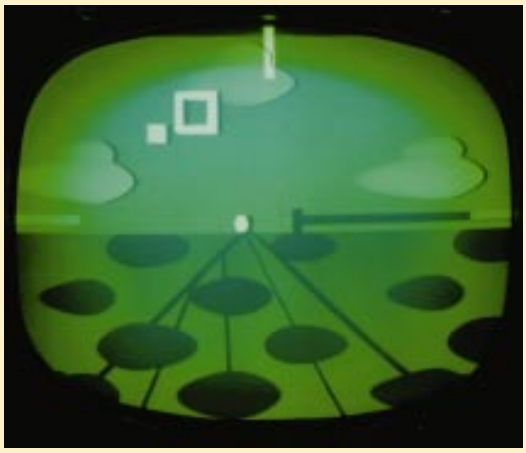
By early 1963, it was possible to initiate avionics Board of Inspection and Survey trials and at the same time to deliver airplanes for replacement training to Attack Squadron (VA) 42 at NAS Oceana, Va. The initial airplanes did not have fully operable avionics, but were adequate to start instructor pilot training. Initial day carrier qualifications were conducted on *Forrestal* (CV 59) in July. Full system airplanes began to arrive soon after and full training for both pilots and bombardier navigators (BN) began. While avionics systems reliability and maintenance continued to be a major concern, the first A-6 fleet squadron, VA-75, started its training.

Vertical Display Indicator

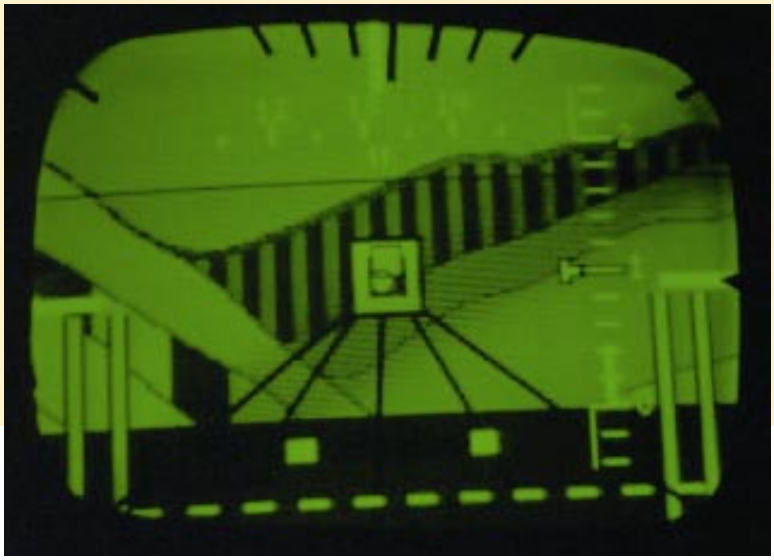
First used in the A2F *Intruder,* the Vertical Display Indicator (VDI) was a forerunner in equipment designed and adapted to fit the way a pilot functions. The VDI was a head-down cathode ray tube display which simulated real-world conditions, enabling a pilot to fly an aircraft during takeoff, navigation, attack maneuvering and landing modes as though in visual contact with his surroundings. This display technique is known as Contact Analog.

The revolutionary "highway in the sky" concept was developed under the Army–Navy Instrumentation Program in response to a need for simplified cockpit instrumentation and all-weather flight capability. Kaiser Aircraft & Electronics (now Kaiser Electronics) built the first instrumentation system in the late 1950s. The original operational display presented ground and sky texture to the pilot with a well-defined horizon for attitude, "highway in the sky" for steering and numerous other symbols for execution of various attack maneuvers. In the mid-seventies heading, radar altitude, vertical speed, angle-of-attack and landing needles were added to the display. Both versions of the VDI provided ground contours for low-altitude terrain avoidance maneuvering while in Terrain Clearance mode.

At upper right is an early VDI. Right, a 1980s-vintage VDI in Terrain Clearance mode with the Tactical Altitude Director (for improved low-altitude safety) on a Target Recognition and Attack Multisensor/Systems Weapon Improvement Program version of the A-6E *Intruder.*



Kaiser Electronics



Off to War

Soon after VA-75 completed its training with VA-42, the events of August 1964 in the Tonkin Gulf led to the country's direct military involvement in the Vietnamese war. By spring 1965, preparations to take the new A-6s to war had progressed to the point where VA-75 deployed with Carrier Air Wing 17 on *Independence* (CVA 61) in May, flying its first missions against North Vietnamese targets in July.

The A-6's initial combat record was anything but auspicious; the *Intruder* suffered problems typical of a new combat aircraft entering operational use and combat simultaneously. Premature explosion of bombs soon after release accounted for the first, and some subsequent, "combat" losses. This and the unreliability and excessive maintenance of the complex integrated avionics systems on which its all-weather bomber capability depended were tackled head on. The first was solved by fusing and wiring changes and adding multiple ejector racks on the five-store pylons. The second was more pervasive and was a continuing problem. These technical aspects led to indecision on operational mission assignments: whether to assign A-6 missions based on large bomb-carrying capability or on all-weather capabilities.

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In standard Navy finish, the first *Intruder* publicly displayed its long span flaps, tilting exhaust nozzles and black speed brakes which opened into the retracted tail pipes' exhaust.

Over the next several years, as subsequent A-6

squadrons rotated through Seventh Fleet duty, both the technical and operational problems reached resolution. Changes were made to various DIANE components, and successful missions in monsoon season weather dispelled planning for follow-on models with reduced avionics systems capabilities. With less emphasis on close support dive-bombing, the fuselage dive brakes were disabled and locked closed, finally being replaced in production by plain skin.

An electronic warfare EA-6A version was developed for the Marines; 28 were converted from A-6As. In combat, they operated from both shore bases and carriers. A fuselage extension forward of the cockpit and an upper fin antenna fairing housed the "electric *Intruder's*" countermeasures systems. Fuselage speed brakes were retained to allow wing tip antennas.

Other special-purpose versions, with systems optimized for surface-to-air missile site attacks with Standard anti-radiation missiles and for around-the-clock attacks against traffic on the Ho Chi Minh Trail, were built in smaller numbers—19 A-6Bs and 12 A-6Cs, respectively. These were integrated into regular A-6 squadrons.

Interest in a tanker version led to 1970 conversions of early A-6s by removing avionics mission systems and installing a rear fuselage-mounted hose and drogue system. The resulting KA-6Ds were also operationally integrated into A-6 squadrons in small numbers.

As avionics digital technology moved rapidly forward, major replacement of DIANE components—including a single multimode radar that could perform both the search and track radar functions, and updated computers—resulted in a "new insides" model, the A-6E, though it arrived too late to see combat in Southeast Asia. To expedite transition to this greatly improved systems capability, As were converted to Es. The A-6As and special variants flew to war's end.

Anywhere, Anytime

Production of new A-6Es and conversion of As to Es continued through the late 1970s. A-6Bs and Cs were phased into the E conversion line as capabilities similar to those of their specialized systems became available. Changes continued to keep the A-6Es up to date. With development of the full Target Recognition and Attack Multisensor (TRAM) system using a small turret-mounted forward-looking infrared sensor, a full update package was established for production, resulting in the A-6E TRAM configuration. In keeping with evolving Navy practice, this became the recognized identification rather than using a revised designation for all new production and remanufactured, upgraded A-6Es. Its TRAM turret under the radome and a ram air inlet on the port side of the upper aft fuselage for additional aft bay systems cooling were among the few external changes made to *Intruders.* Internally, a new carrier airborne inertial navigation system and

In scenes typical of Southeast Asia combat operations, above, a VA-85 A-6A off *Constellation* (CVA 64) drops Snakeye bombs; left, a Marine VMA-225 *Intruder* loaded out with 250-pound bombs; and, below, maintenance crews ready an early VA-85 *Intruder* on *Kitty Hawk* (CVA 63).

Bird Dog Meets Intruder

Capt. R. A. Stewart, USA (Ret.)
Pilot/Forward Air Controller

Cessna O-1E *Bird Dog*

It was a hot day in more ways than one. The bad guys, taking advantage of yesterday's announcement of a bombing halt on North Vietnam, were making my little slice of the demilitarized zone (DMZ) a sizzler. Through the open side window of my Army O-1 *Bird Dog*, I saw an unusual sight below: trucks and North Vietnamese Army (NVA) troops moving in broad daylight! The president said we couldn't run any air strikes but nothing was said about artillery, and some of these targets were in range of our big guns along the edge of the DMZ. So I called for a fire mission, and 75 mm rounds started to rain on the NVA's parade.

My targets were very unhappy about the unexpected interruption and sent up huge streams of antiaircraft fire which, under the rules of engagement, could be returned with "any and all assets." By my logic, that included air strikes. Apparently, the bombing halt had caught the various F-4 *Phantom* and A-4 *Skyhawk* squadrons by surprise, too, and flights already scheduled were begging for targets. I sent in the first flight of fast movers.

Then an unfamiliar call sign checked in, "Catkiller 13, this is Old Salt 18, can we join the party?" I replied, "Ready to copy," and poised my grease pencil against the Plexiglas side window to write down the type of aircraft, number in flight, estimated time of arrival, available weapons and fuel limits to time on station. "Copy what?" he replied, making it apparent that he was not used to little Army-green propeller planes finding his targets for him. I spelled out my request and began to write.

"We're Alpha Sixes off Yankee Station," he said. As he listed what he was carrying, I had to stop and sharpen my grease pencil. His load of ordnance looked like the inventory of an entire squadron. My window was full.

I asked, "What is the call sign of your other flights?" His reply, "There's just two of us," started me rearranging all other flights so I could give these guys the quickest run on the target. Flying in from so far away and with that huge load, they couldn't have much fuel and would have only a brief time on target. Then, he said, "Oh, yeah, we can stay up here as long as you can."

That was a *Bird Dog's* first impression of the incredible A-6 *Intruder.*

new universal missile wiring and pylons were of equal importance to the TRAM in crew effectiveness and combat capability.

The major concern in the 1980s was the increasing problem of older A-6s using up their wing fatigue life. Other military aircraft were suffering similar problems, all aggravated by longer than anticipated service lives, changes in mission usage and increased weight. With the objective of extending the service life of A-6Es, the Navy sought the construction of new, longer life wings, awarding the contract to Boeing for its proposed composite-construction wings.

At the same time, early studies leading toward a stealthy "advanced technology attack" replacement for the A-6 suggested a significantly improved A-6 would be a useful interim development. A contract was signed with Grumman for five development A-6Fs in 1984. These would have the composite wings, a revolutionary radar system and new GE F404 engines. The engines would be the same as those in the F/A-18 *Hornet,* except without afterburners. With other changes to enhance survivability, the A-6F would mark a major improvement in the A-6's effectiveness. While no attention was paid to reduced radar signatures in the A-6F, one can suspect that this was also probably being looked at as a possible further step.

The first A-6F flew in August 1987, the second later that year. By the time the third flew in summer 1988, funding constraints ended the program, except for avionics testing as a possible future upgrade.

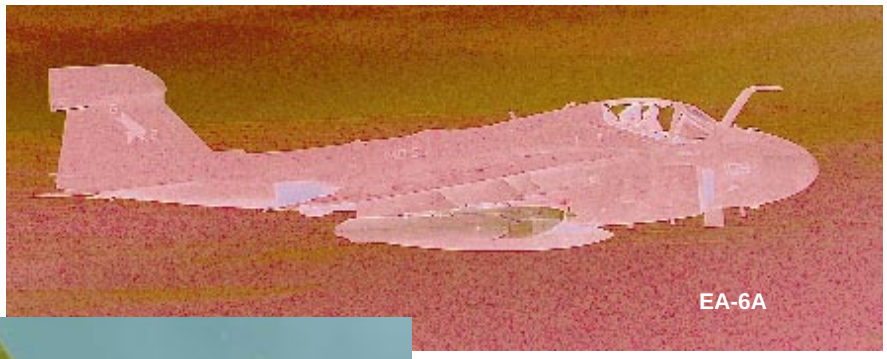
Meanwhile, *Intruders* had seen further combat: over Lebanon in 1983 and more effectively against both Libyan and Iranian vessels and targets in 1986 and 1988, respectively. Several carriers in the eighties operated with two squadrons of A-6s as part of heavy strike wings, with a total of eight squadrons each in Naval Air Forces, U.S. Atlantic and Pacific fleets, five Marine squadrons and two reserve as the decade ended. Only the wing fatigue situation spoiled the picture.

The Marine Corps made plans to transition its A-6 squadrons to F/A-18Ds to assist the Navy inventory, while the Naval Aviation Depots (NADEP) at Alameda, Calif., and Norfolk, Va., undertook additional rewinging to overcome the operational deficit. *Intruders* remained mainstays of the fleet, even as their contemporaries, the F-4 *Phantom* and A-7 *Corsair II,* were being replaced by F/A-18s.

An A-6B takes off carrying its reason for being: two Standard antiradiation missiles, each capable of taking out a surface-to-air missile site.

Reaching the End . . . In Style

Back-to-back 1990 issues of *Naval Aviation News* carried "Grumman A-6: 30 Going On . . . 50?" (Sep–Oct) and "Coming Soon to a Carrier Near You: Avenger" (Nov–Dec). The latter was the first open description of what the A-6's A-12 successor would be. At the time, *Intruders*—two squadrons each on some carriers—made up the long-range strike arm of the carriers assigned to 1990's Operation Desert Shield. The Systems Weapon Improvement Program (SWIP), replacing the old wings with Boeing's composite ones and other upgrades, continued in high gear. With A-12 schedules stretching into the future, the A-6s would certainly approach 50 years before the last were replaced by A-12s.



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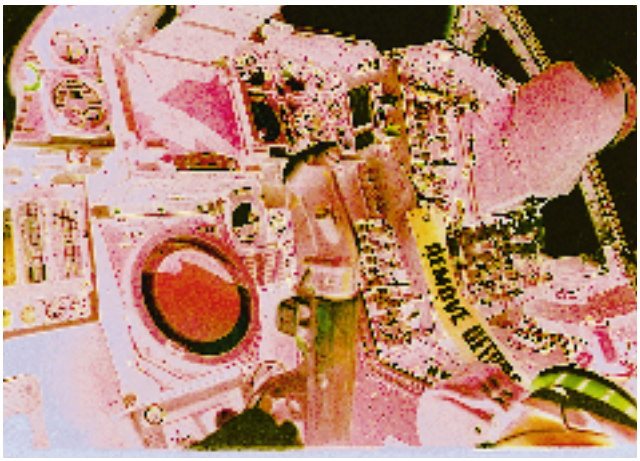
VAQ-33 flew EA-6As to provide the fleet with electronic warfare training, top. EA-6As along with other combat *Intruders* had busy cockpits for both crew, though exact configurations differed: below, an A-6A panel; bottom, a VA-34 crew prepares for a last deployment flight with *Kitty Hawk's* (CV 63) CVW-7 in July 1996. The stillborn A-6F, below left, would have gone to a modern "glass" cockpit.

Northrop Grumman

Northrop Grumman



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On 17 January 1991, Desert Shield became Desert Storm, and *Intruder* squadron aircrews were once again in combat—in a very different geographic scenario from Vietnam. Loss of two Navy A-6s in the first day's action led to tactics revisions, and only one more A-6 was lost to enemy ground fire during the remaining nearly six weeks until the 27 February cease-fire. KA-6Ds and A-6Es using buddy tanker stores were part of an extensive aerial refueling force. Two shore-based Marine A-6 squadrons flew all-weather deep strike and later close air support missions without losses.

Just before Desert Shield transitioned to Desert Storm, the A-12 program was canceled due to cost growth. While lessons from Desert Storm are still being drawn, and argued, the com-

PHAN Kris White

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Above, a BN's view past his pilot, seated slightly forward, as this VA-34 crew flies near *Kennedy* (CV 67) during 1980s peacetime operations. Below, a VA-196 KA-6D with four tanks and an auxiliary centerline buddy store refuels a VF-24 F-14A using its integral hose and drogue system.

Ted Carlson

bination of A-6 capabilities, precision smart weapons and stealth for carrier strike missions was clearly supported by combat experience. The returning A-6 squadrons that were still flying metal-winged airplanes turned them in for upgraded composite wing SWIP versions as rapidly as two NADEPs and two contractors could make them available. The Navy meanwhile initiated a new program to develop an alternative in lieu of the A-12, and another program for a more capable *Super Hornet*, which would overcome the payload/radius and internal volume limitations of the F/A-18.

Succeeding months saw the Marine Corps accelerate replacement of its A-6Es with F/A-18Ds in order to make rewinged A-6Es available for carrier air wings. The various efforts for an A-12 replacement failed to find an affordable approach, and collapse of the Soviet Union placed more pressures on U.S. military expenditures. Potential reductions in total operational squadrons brought an end to A-6E procurement, and deliveries ended in January 1992.

Navy operational units underwent major reductions in 1993 as part of post-cold war cutbacks. Each deployed carrier's air wing still included an A-6E squadron; however, a decision was made to retire the last A-6Es during 1997. With F-14 *Tomcats* picking up the strike role that had been included in

A-6 Squadrons

Navy	Aircraft Models Assigned
VA-34*	A-6A, -B, -C, -E, KA-6D
VA-35**	A-6A, -B, -C, -E, KA-6D
VA-36**	A-6E
VA-42**	A-6A, -B, -C, -E, KA-6D
VA-52**	A-6A, -B, -E, KA-6D
VA-55**	A-6E, KA-6D
VA-65**	A-6A, -B, -E, KA-6D
VA-75**	A-6A, -B, -E, KA-6D
VA-85**	A-6A, -E, KA-6D
VA-95**	A-6A, -B, -E, KA-6D
VA-115*	A-6A, -B, -E, KA-6D
VA-128**	A-6A, -E
VA-145**	A-6A, -B, -C, -E, KA-6D
VA-155**	A-6E, KA-6D
VA-165**	A-6A, -B, -C, -E, KA-6D
VA-176**	A-6A, -C, -E, KA-6D
VA-185**	A-6E, KA-6D
VA-196**	A-6A, -B, -E, KA-6D
VA-205**	A-6E, KA-6D
VA-304**	A-6E, KA-6D
VAH-123**	A-6A
VAQ-33**	EA-6A
VAQ-129	A-6A (now only EA-6B)
VAQ-209	EA-6A (now only EA-6B)
VAQ-309**	EA-6A
VX-5**	A-6A, -B, -E, KA-6

* Redesignated strike fighter (VFA) squadron
** Disestablished

Marine Corps	Aircraft Models Assigned
VMA(AW)-121*	A-6A, -E, KA-6D
VMA(AW)-224*	A-6A, -E, KA-6D
VMA(AW)-225***	A-6A
VMA(AW)-242*	A-6A, -E
VMA(AW)-332*	A-6A, -E
VMA(AW)-533*	A-6A, -E, KA-6D
VMAT(AW)-202**	A-6A, -E
VMAQ-2	A-6E, EA-6A (now only EA-6B)
VMCJ-1**	EA-6A
VMCJ-2****	EA-6A
VMCJ-3**	EA-6A

* Redesignated strike fighter (VMFA[AW]) squadron
** Deactivated
*** Deactivated, reactivated as VMFA(AW)
**** Redesignated VMAQ-2

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From bombing missions in Vietnam to precision night attacks over Iraq, the A-6 had a distinguished history in the Marine Corps. *Intruders* like these from VMA(AW)s 533 and 121 and VMAT(AW) 202 provided dependable all-weather close air support for the Marine air-ground team.

their original design but never operationally implemented, the combined F-14 and F/A-18 air wings could meet mission requirements with one less aircraft model to be supported.

Following final deployments of the last two squadrons, VAs 196 and 75 were disestablished on 28 February and 31 March, 1997, respectively. One hundred composite wing *Intruders* went to the Aerospace Maintenance and Regeneration Center, Davis-Monthan AFB, Ariz., for storage, while mostly older metal and composite-winged versions went to various museum and display locations.

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Flying a Desert Storm mission from *Kennedy* (CV 67), this VA-75 A-6E SWIP carries 12 MK 82 bombs and a centerline tank.

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In a 1983 Mediterranean Sea exercise, a VA-65 A-6E TRAM flies toward *Belknap* (CG 26).

Ungainly looks aside, the *Intruder* served with distinction as the Navy's primary medium-attack aircraft for 34 years—winning our respect and our hearts.

Special thanks to the National Museum of Naval Aviation, Northrop Grumman History Center and the Association of Naval Aviation for providing photos and other assistance in the preparation of this article.