WILLIAM McCLOSKEY

APL SEA DUTY WITH THE SURFACE FLEET

At sea with the Fleet: An SM-2 Standard Missile, fired from the Terrier destroyer USS *Mahan* (DDG-42), roars into the sky toward a drone that had been released by a plane scores of miles away. Aboard the Aegis cruiser USS *Yorktown* (CG-48), located beyond the visual horizon of *Mahan,* the Aegis system provides comprehensive data on the target to *Mahan.* Over the horizon in another direction, the Terrier cruiser USS *Richmond K. Turner* (CG-20) also receives the data from *Yorktown* and stands by, ready to launch one of its own missiles.

The three ships can operate as one because they are tied together by a digital data exchange system. The data exchange system allows *Yorktown* to transmit a continuous Aegis radar picture to the firing ships. Using this information in conjunction with local radar data on an APL-developed Automatic Gridlock System gives each ship its exact relative position at all times to aircraft and other ships.

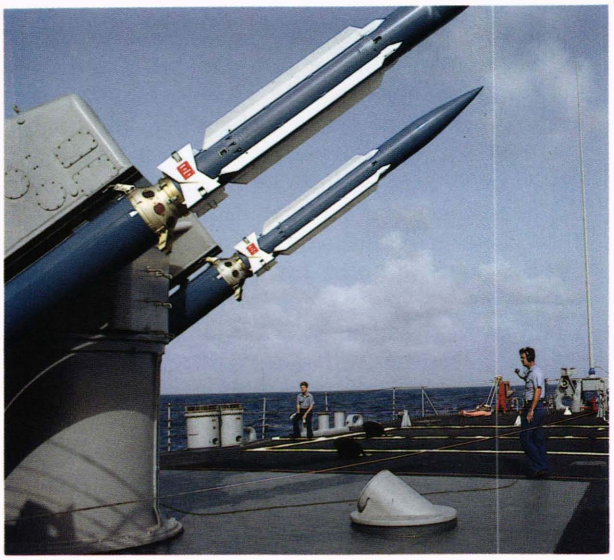
Aboard *Yorktown,* the command center of the operation, dozens of aircraft – simulating both friendlies and hostiles – are also being tracked. When the missile fired by *Mahan* has been guided in space to a strategic point, *Mahan* alone completes the engagement.

The missile homes straight for the drone and destroys it. On the radar scopes in the busy, darkened Combat Information Centers (CIC) of *Mahan, Yorktown,* and *Turner,* the joined image of missile and drone breaks into pieces and disappears. As announced by a fire control chief aboard *Mahan:* "Target video blooming."

"Just like the textbook," says Lieutenant Commander Charles Baker appreciatively. Baker is project test officer for the New Threat Upgrade Program, stationed at the Naval Ship Weapon Systems Engineering Station (NSWSES) at Port Hueneme, Calif.

"Bridge to combat – *direct hit,*" announces the *Mahan* CO, Commander David Bill III, who had calmly directed the firing from CIC. "How far out was that intercept?"

"It was [classified] miles," announces D. W. Peugh of APL. He and Commanders Bill and Baker stood behind a bank of consoles in CIC that were manned by fire control chiefs and operations officers. The three wore earphones that fed multiple channels of information from all the areas of the ship involved in missile launch and guidance. Peugh's big rumbling voice expresses the satisfaction of everybody in the room as he continues: "We hit at [x] miles, where we said we'd hit."



The deck of USS *Mahan* (DDG-42) with Standard Missiles. (Photographs by the author.)

Aboard *Turner,* a duplicate firing team had been standing by, geared (and reportedly eager) to take on the drone if the *Mahan* firing failed. Peugh transmits cheerfully to David Otto of the Naval Ship Weapon System Engineering Station (NSWSES) and Mark Percich of APL on the other ship: "Tell Turner, sorry." He did not sound particularly sorry, after days and nights of tests with his own team, and years of preparation. However, minutes later *Turner* had its chance with another drone, and hit the target with an SM-2 missile. Both *Mahan*'s and *Turner*'s engagements were initiated and aided by the information from *Yorktown.* Indeed, the firings had historic program significance because it was the first time that the experimental coordination procedure had been used to support a live missile launch, and the people aboard all three ships knew it.

For five days before the actual firing, there had been sequence after sequence of simulated firings on live targets, as the men familiarized themselves with the procedures. Ship's radars had simultaneously tracked scores of real planes in the air. The Orange Force – the attack-

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ing enemy – flew from a naval base in the area while the Blue Force – the defenders – flew from the carrier that the rest of the Fleet was protecting. All these flights were too far away from the men on the tracking ships for them to hear any roar of planes. The reality for them was a mass of radar blips on a variety of displays. This is the way much of modern warfare occurs.

BACKGROUND OF A LONG-TERM CONCEPT

The Aegis system's uniqueness is its ability to defend the Fleet against volleys of attacking aircraft. It can track multiple air targets – squadrons of them as thick as a hive of bees – while keeping them straight as friend or foe (or unknown until identified), and simultaneously can guide missiles to the designated air targets. Aegis now also refers to the ships that carry the system – *Ticonderoga, Yorktown*, and *Vincennes* are the lead ships of the Navy's new CG-47 (guided missile cruiser) class with 24 others under construction or projected.

The operational Aegis system is the result of a massive coordinated effort that began in the mid-1960s to design a system to leap ahead of the ever-increasing requirements of Fleet defense against air attack. In 1978, the Navy initiated a companion project for Terrier ships – the New Threat Upgrade (NTU) Program. NTU approximated Aegis combat system architecture through evolutionary changes to the older systems. APL led the Navy team that developed the NTU system, serving as the Navy's Technical Direction Agent for the effort. The resulting system design is now also being applied to a number of Tartar ships.

The firings were an engineering test for BGAAWC – Battle Group Anti-Air Warfare Coordination. This program is directed at enhancing Fleet AAW capabilities through a coordinated use of forces. APL also serves as Technical Direction Agent of BGAAWC. The firings occurred during a large Fleet exercise that involved the carrier *Saratoga* and many other ships. However, only *Yorktown. Mahan,* and *Turner* participated in the coordination experiment.

The concept being demonstrated at sea had been developed for the Navy by a team led by APL. Aboard the three ships, members of the team served as test advisors to Navy personnel on operating the systems they had developed under NAVSEA (Naval Sea Systems Command). The teams were headed by D. W. Peugh of APL aboard *Mahan,* William Mehlman of APL aboard *Yorktown,* and by David Otto of NSWSES and Mark Percich of APL aboard *Turner.* Ashore at the naval base, a monitoring group headed by Kenneth Wolfe and Hugh Wilson of APL followed the exercise from a land tracking facility. Wolfe had responsibility for coordinating the entire experiment.

Besides being the first missile firings using the new coordination concept, the at-sea tests also marked the first time that a multiship NAVSEA engineering experiment had been conducted as part of a Fleet exercise. Shipboard officers and crewmen, not engineers, had performed the firing and tracking. As put by one involved observer: "The parameters of a weapons system invite certain tactics. For example, the design allows you to do some things better than others. The engineers understand the system, but don't necessarily understand Fleet tactics, while the Fleet people understand tactics without necessarily understanding the system design. The answer is to have the engineers work more closely with the operators; while this seems obvious, in practice the two groups are not that accustomed to this type of close cooperation." Thus, the successful hits involving three ships were considered a major step in the area of Battle Group Engineering.

In this experimental program, APL answers to NAVSEA but carries total responsibility for the teams it has assembled. Such a concept does not spring up overnight, and many of the team had been working on it nonstop since 1984, while providing a similar concentration on the related New Threat Upgrade program.

At APL, the history of New Threat Upgrade began under Marion E. Oliver who, along with James W. Schneider and Terry R. Betzer, among others, first formulated the concept for the Navy. According to Schneider, program manager for Surface Combat Systems (which includes NTU and Aegis) who comes to his post with long experience on Terrier and Talos: "Our business has been to develop material and procedures. We're systems engineers working at a number of levels from microwave tube development and high-powered transmitters to total shipboard combat systems. Much of this effort requires taking data at sea during exercises, then bringing it back to study for the insights it can bring on the quality of performance and on areas that may require change." George Emch of the program office, who has been identified for most of his career with shipboard combat systems, added: "It's important that we go to sea for another reason. Equipment that sits on land never bends, never stretches, while in the real environment a ship rolls and pitches. Our engineers always have to remember this. Through the magic of magnetic tape, we can then analyze the equipment back ashore. There's a good deal of signal processing that amounts to looking for needles in haystacks, and this is better, many times, done at first on land."

The New Threat Upgrade program requires frequent work at sea. Among others, D. W. Peugh rides ships for multimonth periods. His presence during the relatively brief exercise aboard *Mahan* was, in fact, "borrowed" from time aboard USS *Virginia,* a relatively new ship (commissioned in 1976), which he was helping to prepare for another test and evaluation evolution. ("Probably my biggest job is to keep all the contractors talking to one another and especially to me.") His assignment aboard *Mahan* was a concentrated version of the one aboard *Virginia.*

The APL role in a test begins with preparing test procedures, performing the administrative work, and marshalling the resources necessary to conduct the test. (A past example of the latter: for shipboard missile test firings, a target was needed to fly in and dive at a ship. The Navy had no such target. APL worked with Beech Aircraft to modify an existing target and build the type

of drone that is now the standard target for missile firing exercises.) Then, aboard ship, according to Peugh: "Your job is to make sure everything happens" – that the crew is trained to operate the equipment, that the ship is instrumented to record the firing data, and that the equipment operates as designed. "Our job is to make this thing work when its gets to sea, and then to record it for analysis." Of the civilian team that APL heads, Peugh has nothing but praise. Many have worked together for years – Paul Hause of APL and Peugh, for example, since 1965. As for attitude: "Once you get on this ship you're a Navy man. Your allegiance to the ship is primary, not to any company. Hundreds of people have literally dedicated their lives to these programs."

HONING THE TEST PLAN

At APL, in Howard County, Maryland, 8:30 a.m., several weeks before the at-sea firings: The meeting started late because Johns Hopkins Road (leading to APL) had been narrowed to a single lane by construction equipment. About 20 people gathered in a conference room one by one, filling styrofoam cups with coffee and talking among themselves. Most had known each other and worked together for so long that conversations seemed less to begin than to resume where they had left off. The talk was good humored, but it all appeared to be a variant of the business at hand.

The purpose of the meeting was to review the test plan for the experimental firings. Those present included Commanders William Kyle and Francis Williamson, project leaders at NAVSEA for Aegis and New Threat Upgrade, respectively. It also included representatives from several contractors including ASCEAC (Advanced System Combat Engineering Analysis Corp.), Delex, and Mantech.

The meeting was a nuts and bolts, shirtsleeves affair. The coordination concept had been developed on drawing boards and simulated in computers. Now it was being translated into action, step by step. Where should ships and targets be located? What kind of data had to be collected and who was responsible for collecting each part of it?

Bill Mehlman of APL made the initial presentation, to summarize the instrumentation that would be involved. Then Keith Hirt of ASCEAC explained the plan in overview. Attendees had received preliminary copies and had studied them. The plan had been drafted by ASCEAC, and Hirt and co-author Mike Hodgkiss of the contractor company stood by to answer questions.

Ken Wolfe of APL conducted a line-by-line review of the plan, since the plan came under his responsibility as NTU project engineer for the Fleet Systems Department. The talk, sometimes salty, hit a point squarely and passed to the next as pens scribbled changes and notes.

– "Somebody has to verify that the range is clear for firing. I'm missing that. It doesn't say in here – I kept looking – that it's the responsibility of *Yorktown* to sanitize the range." (Commander Williamson: "OCE is responsible.") "OK, let's write that in."

– "We want to keep procedures identical on each ship as much as possible. We don't have time to train.... Anybody have any complaints about paragraph eleven? OK, pass to twelve."

– "I have a problem with number fifteen."

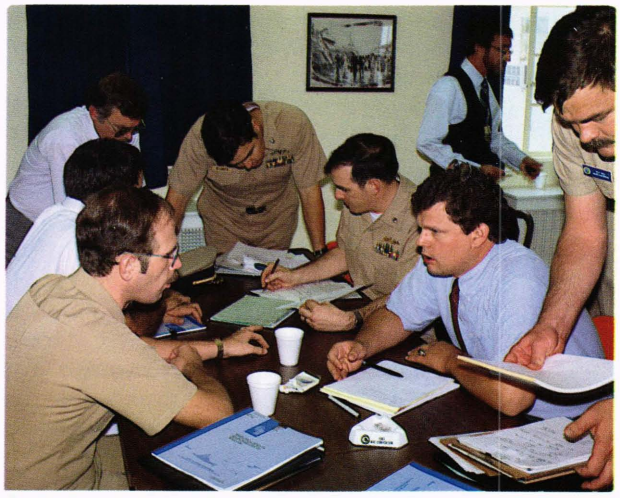
Wolfe of APL, after the group had considered several qualifying additions: "We don't want to bind ourselves so tight that we can't conduct the exercise. If it's not critical, don't add it.... Let's not confuse the troops, OK?"

The session broke for lunch. The smoke in the room had grown so thick that much of it still lingered when they returned. Coffee, cigarettes, and concentration characterized the day. By the time the meeting had ended, the master copy of the test plan lay covered with notes. The participants, heading back toward Washington in traffic lines that started at the construction site on Johns Hopkins Road, had the classic rumpled look of tired businessmen.

READINESS REVIEW AT A NAVAL BASE

A month before at-sea exercises: The readiness review took place in a nondescript low building resembling many others. The purpose was to bring together the developers of the experiment with the naval officers heading the commands responsible for the upcoming Fleet exercises (of which the experiment would be one of many) in order to review the objectives of the test and the planned distribution of responsibilities. (The week before, some of the same naval officers and civilians as well as others connected with the Fleet exercise had participated in an extended schedule review called "commuter week." Representatives of the various commands involved in the Fleet exercise had given extensive presentations of their goals. From this came the framework for the Test Readiness Review.)

The business of the first day, according to one attendee, was to "thrash out the details of readiness review at the working level." This level included commander-



Participants in a Readiness Review in shirtsleeves atmosphere on the first day. Clockwise around the table from front left are Commander Pat Roll, CCDG-8; (unidentified); Dave Otto, NSWSES; Commander Francis Williamson, NAVSEA-06; Commander William Kyle, PMS-400; Mike Hodgkiss, ASCEAC; and Commander Clifford Hill CCG-4.

level officers of NAVSEA and of the ships and Fleet commands participating in the exercise, as well as the heads of several civilian groups who acted principally as technical advisors. There were such questions to be decided as the party responsible for obtaining the drones, the types of drone (some heated discussion on this), how the ships were to be positioned, and the entire sequence of events.

The atmosphere quickly turned more animated than that during the test plan meeting at APL in which the particpants had worked together before. At this larger meeting there were more turfs involved. Besides full-table discussions among some 40 attendees, the meeting took frequent coffee breaks that became essentially huddles to review and finalize some detail.

On the second day, naval representatives presented the readiness plan to a high-ranking mission control panel of six. The panel included Rear Admiral David E. Jeremiah, Commander Cruiser Destroyer Group Eight; Rear Admiral James F. Dorsey, Commander Carrier Group Four; Rear Admiral Lowell Holloway, NAVSEA Assistant Deputy Commander for AAW and Surface Warfare Systems; Commander Richard Fantauzzo, of NSWSES; James W. Schneider of APL, Surface Combat Systems program manager; and Dale Anderson of General Dynamics/Pomona, builders of Standard Missile.

Commander Francis Williamson of NAVSEA reviewed for the panel the results of earlier, simulated firings conducted by *Ticonderoga* and *Mahan* as well as additional exercises conducted aboard *Yorktown* and *Turner*. The first exercise, he said, demonstrated the feasibility of the technique and identified some necessary computer program modifications. A second exercise demonstrated the technique further while uncovering additional areas for modification. Analysis of data from the second exercise also determined several requirements for a successful coordinated engagement that he named. Williamson then reviewed the scenario for the forthcoming exercise as well as other requirements for a built-in casualty condition.

Other presentations followed, including one by a naval officer who said that the firing would carry the same risks as any other made under operational conditions, and that while range safety conditions would be slightly different, he anticipated no problems. W. G. Peoples of General Dynamics/Pomona presented the results of simulated missile runs that had intercepted targets at different distances and said that the simulations indicated a high probability of success for a live firing.

The commanding officer of *Yorktown,* Captain Carl A. Anderson, reported the readiness of his ship to support the exercise. On the day before, Captain Anderson had expressed concern that the schedule did not identify decision points for various options, and NAVSEA now told him they would provide them. Lieutenant J. Sarcone of *Mahan* noted that his ship had conducted successful simulated firings in previous exercises, and was ready for the live exercise. Lieutenant Commander R. J. Norton of *Turner* reported that his ship also was ready, and was eager to fire if *Mahan* missed. (These sessions were too businesslike to be rich in laughs, but Norton's comment drew an appreciative chuckle.)

After the presentations, the meeting room was cleared except for the six panel members who reviewed the report behind closed doors. The other participants spilled out into the hallway and adjacent offices of the facility. Their own discussions continued, many with the earnestness of involvement. At approximately noon, the panel members readmitted the other participants and announced their intention to proceed with the missile firing exercise on the basis of the presentations made at the review. In addition to approvals, the panel added some additional action items of its own to certain of the participating commands.

INSTALLING INSTRUMENTATION ABOARD SHIP

APL, Howard County, 7 a.m.: As early employees parked, I met Bill Mehlman and Ken Plantz and we took off for the naval base in a Lab car. An APL van loaded with equipment had started ahead of us, as well as another car with an installation crew. Mehlman explained the day's project succinctly: "This is the first time we're putting APL equipment aboard an Aegis

Panel members and other participants in the Readiness Review on the second day. Left to right around the table are Rear Admiral David Jeremiah, CCDG-8; Rear Admiral James Dorsey, CCG-4; James Schneider, APL; Captain Hugh Webb, NAVSEA-06; and Kenneth Wolfe, APL. In the rear are Mark Percich, APL; Mike Hodgkiss, ASCE-AC; Doug Osborne, APL; and Ken Plantz, APL.

ship." The ship was the recently commissioned Aegis cruiser *Yorktown*. The equipment was a portable system that could process the data of a live firing onboard within an hour of the actual firing time.

The shipboard minicomputer system had been developed at APL with the hardware supervised by Hugh Wilson and the programming by Edward Wetzlar working with Plantz. The system, used previously on Terrier and Tartar ships, had now been modified for Aegis. Before, the data from an experimental missile firing afloat could not be processed immediately into meaningful form – not until it reached a larger computer facility ashore than was practical to install on a ship in competition with its other computer systems.

The new equipment fitted into a 5-foot rack. According to Plantz, who would be operating it aboard *Yorktown* during the experiment: "We'll be able to take the tape from the tape drive, right aboard ship, walk over to this new system – which is off line and doesn't affect any combat system – and process the data right there. Within an hour of actual firing time on the ship we'll produce a series of summary plots, printouts, or whatever is needed, take them to the captain, and say OK, here's what you just did on your firing. That's one thing. For the experiment we'll also hope to use the computer for readings useful to the ship in evaluating the performance of its data links and radars in certain environments. The consoles in CIC can only permit a certain number of observations. The new portable computer should give us a look at data that's one level deeper."

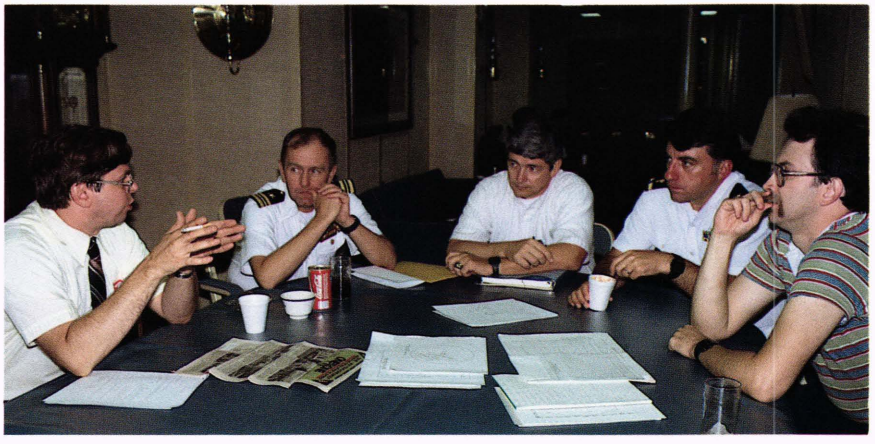
Upon completion of our drive to the naval base, we learned that *Yorktown* had not yet arrived. Nearby, a group of civilians awaited the return of a destroyer from maneuvers. When that ship docked, we watched a ceremony as old as seafaring, as a stream of men filtered off to kiss wives, hold kids, and head home. We located the other APL group as well as the APL van, hemmed in by all the cars, with driver Keith Pickett stoically guarding his consignment. Since it now appeared that *Yorktown* would neither dock until late afternoon nor be ready to receive us on board until later, Mehlman decided to load the equipment into the station wagons and release the driver to return home. Everybody pitched in to carry consoles, boxes, frames. A 5-foot rack had to be tied on a wagon's roof. We stuffed the rest more-or-less neatly around the passenger seats. After getting hamburgers at a fast food hut on base – it would have required extensive paper work at the guard gate to leave and return with all the equipment—we settled in at the BOQ (bachelor officers' quarters) for a wait that turned out to extend into dinnertime.

Later in the day we watched our ship dock. Like all large Navy ships, at least to the uninitiated, the 566-foot *Yorktown* was impressive when viewed alongside. Awesome. The decks, missiles, and superstructure towered in a mass a hundred feet above pier level; the busy men high on the bridge appeared small and remote compared to the gray steel surrounding them that they controlled. A big radar dish turned slowly, deliberately, from the mast.

Out on the nearby waters, craft passed by of all sizes from dinghies to freighters as a red sun slipped through clouds and down the horizon. A Navy cruiser coming to port has priority uses for its brow (gangway) before equipment can be brought aboard – bags and bags of garbage to be piled on the pier, hundreds of men checking out for liberty with a salute to the quarterdeck. Thus it was dark, after 9 p.m., before we were able to shoulder the boxes and cartons and start carrying them up ladders and across decks to Computer Central. Halfway through, the ship sounded a security breach alarm. (Since such exercises are not announced as drills they have the tension of the real thing.) Everyone aboard was required to remain rooted where he stood. The drill lasted a half hour. It had begun to drizzle, but not enough to drench the men caught on the open deck.

Computer Central aboard *Yorktown* was a closed area entered only by code punch. It consisted of two long central blocks of computers flanked by other equipment along the bulkheads. Coming from outside, one smelled the light oily odor peculiar to electronics equipment, and then became accustomed to it. Overhead blowers blasted cold air. To stand under it was to shiver, although a few feet away, the heat generated by the computers helped mix the air to a comfortable temperature.

The installation team included Howard Taylor of the APL carpenter shop and APL subcontractors N. C. "Chad" Moore of EAI and Jerry Miguel of General



Wardroom of USS *Yorktown* (CG-48). Officers and the APL team confer informally over plans for the forthcoming experiment and the installation of a portable data processing unit. Left to right are Bill Mehlman, APL; Lieutenant Commander Dan Mulhall, Operations Officer; Keith Hirt, ACSEAC; CWO Dan Pinto, Combat Systems Test Officer; and Ken Plantz, APL.

Physics. After discussions with the ship's combat system officer and the fire controlman on duty to confirm the location for the new equipment, the three men set to work. They had agreed to do the job without making permanent alterations to other equipment. Taylor used aluminum angle irons to secure the rack against the bulkhead, then built a table to hold a high-speed printer. The others fitted the components into the rack and installed them as a system. The cramped space required twisting and crawling into tight corners, sometimes near-headstands.

Meanwhile in the wardroom, Mehlman, acting as intermediary since he had ridden *Yorktown* previously and would be aboard during the experiment as head of the advisory team, discussed the forthcoming exercise with the operations officer, Lieutenant Commander Dan Mulhall, and others. Across the table, Plantz explained the operation and capabilities of the minicomputer to the chief warrant officer, "Gunner" Dan Pinto, the man responsible for the facility where it was being installed.

Past midnight: Topside, the watch quartermaster stood under shelter as a heavy squall sent cascades of water from deck to deck. In Computer Central, the team worked in a straight line, close to the point where they could make test runs, while discussions in the wardroom continued with diagrams and notepads spread on the table.

Around 0100, Plantz, who made periodic visits to the installation site, offered CWO Pinto a demonstration of the portable data processing unit. Pinto, after seeing the rapidity with which the equipment produced meaningful information (and perhaps noting that his Control Computer room had not been damaged in any way), reacted with enthusiasm. The enthusiasm continued next day with high-level demonstrations that Plantz stayed over to give.

Mehlman had an 0830 meeting next morning at APL. As we drove back to Baltimore along wet, near-deserted highways, he observed: "On a program like this you don't have your own schedule. The ship works 24 hours a day. There's no way to expect the Navy to fit into a nine-to-five routine. That gets frustrating at times because your support back at the Lab is eight to six at most, and if you need a clearance, or a part sent at once, and it's three in the morning, too bad." We arrived back at the APL parking lot around 0600, 23 hours after we had left the morning before. That gave Mehlman 2½ hours of leisure before his meeting.

A TROPICAL CRUISE, NAVY-STYLE

A civilian's ride aboard a Navy ship during Fleet exercises is not necessarily a joy ride, even though the sun might be shining on the water. A group of us arrived late afternoon at the naval base that would support the Fleet exercises, and were told to be ready to go from the base airport by 0600 the next morning. At that hour, close to dawn, while we yawned and privately wondered about breakfast (the only food available appeared to be barbecued Fritos from a vending machine) we were duly checked in. But no flight would be able to take us to the ships until 1430, it turned out. They told us we could make ourselves comfortable in a row of chairs, or a jeep could be found to return us to the BOQ for the eight-hour wait.

Aboard USS *Yorktown,* Ken Plantz, APL, demonstrates to CWO Dan Pinto, Combat Systems Test Officer, a portable data processing unit that the APL team had just installed in the *Yorktown* Computer Central facility. Watching are FCM-2 Robert Turner, USS *Mahan,* and Bill Mehlman, APL.

Meanwhile, a small cafeteria in the building opened. Just as we settled down to a plastic plateful of scrambled eggs, someone came to tell us a chopper was there to take us *immediately*. We ran, still chewing eggs. Out on the noisy tarmac they fitted us with inflatable vests and flight helmets. Aboard the CH-46 chopper, we strapped into bucket seats along the side. A crewman reviewed safety precautions in dumbshow since the noise of rotors was too loud for speech to penetrate the earmuffs of our helmets except by shouting straight into the ear. About seven minutes after sitting down to the scrambled eggs, we looked down on blue water.

During the next half hour, we passed and circled enough gray-painted Navy ships to appreciate the size of the Fleet exercise; in fact, subsequent chats with fellow passengers showed that civilians were not only traveling out for the coordinated firing experiment but for a variety of other exercises. At 0700 we landed on the flight deck of *San Diego* (AFS-6). A crewman told us to stack our bags inside the hangar, and the chopper took off again, without us. A dispatch officer took all our names and our destinations. The flight crews were friendly – everybody had been – but quite busy. Nobody knew how long we would wait. By now the vests and helmets had us sweating as the July morning grew hotter. Shortly the chopper returned with another load of civilians to be sorted.

I had been traveling with Mike Hodgkiss of ASCEAC and Fred Moeckel of NSWSES, both mem-

bers of the experiment team headed for *Turner.* The dispatcher called their names, and the chopper took them off to their destination. I fell in with a new arrival, Bob Fitzgerald, a civilian missile telemetry engineer with Naval Sea Support Center Atlantic (NAVSEACENLANT) whose destination was also *Mahan.* They showed about a dozen of us to the wardroom where we waited, grateful for the air conditioning. At lunchtime the ship's mess officer invited us to eat with everyone else. At 1500, eight hours after our arrival, a dispatcher summoned us back to the steamy hangar. On deck, a CH-46 waited, its rotors churning. The ride this time lasted three hours, with several landings throughout the Fleet and a refueling stop. Finally at 1800, with little light left in the sky, we hovered over *Mahan.*

Mahan does not have a deck to accommodate this size helicopter. A chopper crewman summoned me to the open forward bay and fitted a padded halter under my arms. Outside, I could see sky and superstructure, and directly below that, the *Mahan* deck with flight crewmen wearing bright color-coded jackets. "Cross your arms in front of you over the halter, cross your ankles, and relax. OK?" O.K. Carefully the crewman eased me out the open bay until I swung suspended from a cable under the windrush of the chopper blades. The halter became a rib-puller as the cable eased me down, slowly rotating. Just before I reached deck, a crewman touched me with a rod to absorb static electricity. Another supported me as my feet landed, then pointed the direction toward safety. It took less than a minute, with the actual ride through the air a matter of seconds. Long seconds.

The crew's chow line had nearly closed, but a trayful of food remained. The quartermaster then handed me sheets, pillowcase, and blanket and wrote down my berthing assignment. The first period on any large ship is disorienting, with all passageways and people looking the same. (*Mahan* is 512 feet long and carries 400 men.) After two or three false starts and friendly directions from passing crewmen, I found my billet on a deck below and several compartments forward, past rows of tiered bunks and knots of men changing watch. My bunk was on the third tier, with eighteen inches clearance between the mattress and a series of overhead pipes, so that it required a climb and a slither to settle in. Other civilians had less comfortable accommodations. Some were forced to roll out sleeping bags on deck. There were more than 30 of us to be berthed, aboard a ship that already carried the full Navy complement for which it had been designed.

As it turned out, many of the civilians riding aboard for various exercises spent little time in their bunks except for actual sleep. Those involved in the experiment, for example, participated over several days in a series of test runs whose subsequent review and documentation often continued beyond taps and lights out at 2200. Then inevitably at 0600 came a shrill bosun's pipe over the loudspeakers and the time-honored Navy call: *"Reveille reveille reveille. All hands heave out and trice up. The smoking lamp is lit in all berthing spaces."* Bright lights turned on everywhere, followed by the upward drift of cigarette smoke, and sack time ended abruptly.

THE CENTER OF OPERATION

The experimental team had its headquarters in the Commodore's cabin, a VIP facility adjacent to the cabin of the commanding officer close to the bridge and the CIC. Here, in a sitting room with a table, desk, and several chairs, participants could write reports and discuss plans. As people settled to their routines, and became absorbed in work, they forgot any inherent discomforts. Often someone had to say arbitrarily: "OK, let's knock off and get some sleep," because there was so much to do.

The experimental operation aboard *Mahan,* headed by D. W. Peugh, consisted of three groups: *Command & Control,* under Charles McLellan; *Engagement,* under Paul Hause; and *Detection*, under Mel Martinson. McLellan heads the Mantech Services team that contracts to APL. Hause, a retired Navy chief petty officer, is a member of the APL Combat Systems Development Group (and, as with Peugh, a 20-year veteran of New

A civilian passenger descending by bridle from a CH-46 helicopter to the deck of USS *Mahan* (DDG-42).

Threat Upgrade and its predecessors). Martinson is a search radar engineer with Beta[2], another APL contractor.

There were also two frequent visitor/consultants to the office: Lieutenant Commander Charles Baker, New Threat Upgrade Project officer from NSWSES in Port Hueneme, and James Wheeler, a retired Navy chief petty officer employed by Mantech, but working for the Navy as part of its Combat Systems Mobile Team Training Unit.

After each exercise the heads of the groups convened informally to compare notes. Of one simulated-fire series, Peugh declared: "Last run was a good run, a very good run, and that's the one we want to be reducing the data on." McLellan and Baker agreed. Some of the earlier runs drew a more problematical assessment. But everyone noted a steady, dramatic improvement in the performance of ships' personnel as continuing runs increased their confidence in handling the consoles and procedures.

The team under Peugh needed to make sure that all data systems were coordinated with the actual firing. It then collected the data for further study and analysis. Peugh explained: "after tests, we have to certify that yes, the ship is trained in the system and yes the system can be maintained, and we have to tell of any deficiencies in the systems that we know won't pass."

SCHEDULING TOWARD A COUNTDOWN

Aboard *Mahan* the actual live firing was preceded by days of test runs and briefings. The first MR (manned raid) was held from 0800 to 1100. It included tracking simulated missiles launched from both aircraft and submarines. At midday in the wardroom, the Commanding Officer, Commander David Bill, gathered everyone involved in the experiment to discuss the first test run as well as the purpose of the entire exercise. He outlined the schedule that would lead to the live firing. Another MR run followed that afternoon, and then a series of other test runs.

The next day was busy. The first LF (live firing) test began at 0400 and continued for seven hours. After lunch and a briefing (see below), Manned Raid-3 took place from 1600 to 1900, followed immediately by the first experiment rehearsal that lasted until 2100 – another five hours. Most of the day after that was left open to permit the team to collect notes, write reports, and make any needed decisions, with only a three-hour MR-4 scheduled in the early evening. On the day of the firing itself, another LF began before dawn and continued into the firing itself.

On the second day, between the two long runs, APL called a meeting in the wardroom for all contractors and ship's personnel involved in the experiment. Attendees included everyone from the commanding officer to the fire control technicians, with seats at the long table filled and men crowded against the bulkheads. The atmosphere was attentive, even charged. The officers and chiefs who were operating the principal consoles had caught the spirit of the chase, and the excitement had rubbed off on everyone else. Their proficiency in working with the system had increased by the hour during the test runs.

Peugh of APL conducted the meeting. A big man with a voice to match, he had little trouble holding everyone's attention. "The things I really want to discuss here," he began, "are the processes necessary to ensure that we get a good test out of this." He took the elements of the exercise step by step, beginning with the drone launch. "The very first thing we have to do is check the instrumentation on the drone. Let's not wait for *Yorktown* to tell us to check the drone, let's get that nonfiring director out there, and see if we can track that drone."

Peugh continued with a discussion of track quality and other phases of the firing. "Remember," he emphasized, "this is an engineering test and it's the data that's important." He pointed out that once the shot ended, "we've got to get the data all together quickly, because I know there's going to be a helo here in about an hour to pick it up and take it ashore." Numerous questions. The meeting ended shortly before the start of the next test run.

THE COMBAT INFORMATION CENTER

The traditional command center of a seagoing vessel is the wheelhouse or bridge. From that upper deck position, over the centuries, the captain or the watch officer has been able to see best the conditions on which he needed to base decisions. Remote-sensing electronics have altered this on ships of war. Radars and echo sounders in their basic forms fit comfortably enough in the wheelhouse, but the sophistication of the equipment that now defends a warship from air and undersea attacks, or that initiates attacks, necessitates its concentration elsewhere.

While a watch officer still mans the bridge, the information he follows (except for that regarding local surface navigation) now usually emanates from the Combat Information Center (CIC) close by. During combat or combat exercises, the commanding officer is more likely to be found in CIC.

A CIC is usually kept dark to accustom the eyes to a low light level. The *Mahan* CIC during test runs had

CIC, USS *Mahan* (DDG-42). D. W. Peugh, APL, confers with Lieutenant Commander Jake Shufford, Operations Officer, during simulated firing exercises.

the smells of electronics oil and cigarette smoke, the noises of electronic beeps and voices. Some two dozen men – many with headphones – occupied several posts including a central plotting table, banks of consoles, plotting boards, and racks of computer and radio equipment. In lower CIC, another dozen men operated consoles. The officers, chiefs, and enlisted men seated or bending over the consoles had faces etched in yellow-green from the scopes and hair tinted blue from the overhead light. The air seemed particularly heavy during rough weather, when the invisible sea made itself felt with a rocking deck. In the general melange of voices, phrases and sentences emerged:

– "We have that ID friendly, let's check that ID."
– "OK, we're going to try it again now."
– "Number 5652 has just been designated as hostile."
– "Can you try to get a gridlock on 4347?"
– Peugh, during a lull: "This war'll just have to wait until I get some coffee."
– "Birds away" (referring to missiles being fired; in this case, a simulation).
– Chief on console, while tracking a whole series of simulated missiles headed toward live drone targets: "We ain't dropped one yet, ain't going to either, hell no."

All the systems of the engineering test come together in lower CIC under the group called Detection. Here, crewmen with specialist ratings man individual consoles connected to the ship's SPS-48 three-dimensional radar and SPS-49 air search radar as well as to the AN/SYS-2 integrated automatic detection and tracking system. The operators manipulate the radar controls to achieve the best picture.

According to Mel Martinson, APL contractor in charge of detection: "Our job is conducting test controls and getting good accurate data and notes. The job starts long before the test – making sure all the equipment is on board and working, that personnel are ready to do their jobs." A young fire controlman seated at one console obligingly explained the keys he punched deftly to display a multitude of moving symbols on his display and the meaning of the symbols. Since it was a preliminary period before a run, he invited me to take over. We were dealing with multiple air targets and with constantly changing pictures. After 15 minutes, I was dizzy; I came away with a new respect for the men who direct their skills toward modern antiair warfare.

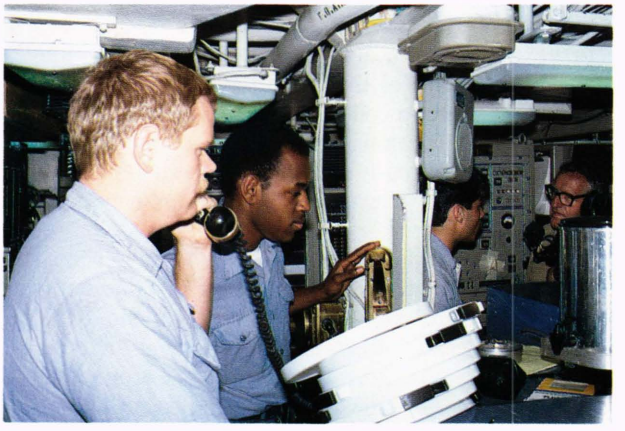
THE SHIP-WIDE COMPLEX FOR GATHERING DATA

A large warship is a network of passageways and compartments on several deck levels. The after-plot compartment is located far from the bridge and CIC is down two sets of ladders, through the mess deck, down two further sets of ladders, through a berthing compartment. A watertight hatch secures the compartment (you have to duck to enter) and a restriction posted outside warns away the unauthorized. Inside are close-ranged banks of computers. The overhead, layered with ducts and cables, has clearance for a man of normal height, but it would be bumpy going for a basketball type.

Paul Hause of APL worked here during most of the exercise—training, advising, and participating. "You can get tons of data," he explained, "but it won't do you any good unless you know what to look for and sort out." He commented particularly on the devotion and accuracy of the group aboard *Mahan*. His activity continued beyond exercises. Often I passed him at a corner table in the mess deck conferring over data sheets with one or two of the men working with him.

Several decks up from after-plot and a few zigzags beyond stands guidance-radar country. Painted on the entrance panel is a picture – blue sky and puffy clouds – of a jet aircraft being hit directly by a flying missile. Inside, air conditioned to the point of refrigeration, stands a bank of consoles fed from an adjoining room by rows of computers. Adviser on data gathering from the guidance radars is Frank Marcott, a young APL engineer who answers to Hause. As with many small specialized groups on board ship, this appears to be one that has nested into its quarters. Marcott even unrolled his sleeping bag at nights on the deck between computers.

CIC, USS *Mahan* (DDG-42). A conference following a simulated test firing. Left to right are Commander David Bill, Commanding Officer; D. W. Peugh, APL; James Wheeler, Navy Combat Systems Mobile Team Training Unit; and Charles McLellan, head of Mantech Services.



The USS *Mahan* after-plot compartment. Left to right are FC-2 Paul Marcoux, FC-3 Robert Lewis, FC-2 Samuel Eber, and Paul Hause, APL.

REFRESHMENT AT THE END OF A LONG TRIP

D. W. Peugh has spent a large part of his career on the engineering of ships' defense both as a Navy man (a retired Lieutenant Commander who rose through the ranks to chief petty officer and then became a commissioned officer) and as a representative of APL. "I've been riding ships for 45 years." When he began his APL assignment in 1965: "I thought this would be a short-term project, but one development called for another development.... I think it's going to continue this way." Peugh noted of a young APL engineer working under him on the team: "He's what we need in this program – very smart and very young. Those of us who started the program, we're all gettin' old. We need some young people."

Aboard *Mahan,* after the successful completion of the experiment, the Commanding Officer spoke to the crew over the ship's speaker system. He outlined the results of the exercise and concluded: "Again well done. I thank each of you for your hard work." He himself had participated enthusiastically from his command post in CIC and had declared himself happy with the results.

It was time for the civilians to leave. A Navy auxiliary ship came alongside *Mahan* for an elaborate refueling operation at sea. While the long fuel hose was being inched across the surging water between the two ships (which continued underway) a helicopter strapped most of us back aboard and transferred us to the other ship's deck. About 1500, another helicopter transferred us to a frigate. There we spent the night in a new arrangement of crowded berthing assignments. By the end of the second day, the frigate had carried us within sight of the naval base, and a launch took us the rest of the way. On the pier, Hugh Wilson and Ken Wolfe of APL waited to greet the entire team with a traditional station wagonload of cold beer. (Remember, there is no alcohol aboard any Navy ship.) Soon after, the key members of the team went on to quarters at the base. There, for the next two days, they remained sequestered until they had completed their reports. Meanwhile, the data from the experiment had arrived back at APL and processing had begun. Only the sea-duty part of the exercise had ended.

USS *Mahan* (DDG-42).