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Lieutenant Richard M. Smith's somber photograph of TA-4J Skyhawks in echelon formation over NAS Kingsville, Texas, is one of ten winners of this year's Naval and Maritime Photo Contest. The other winners will be published in a forthcoming issue of the *Proceedings*.

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Backfire: Long Shadow on the Sea-Lanes

By William D. O'Neil

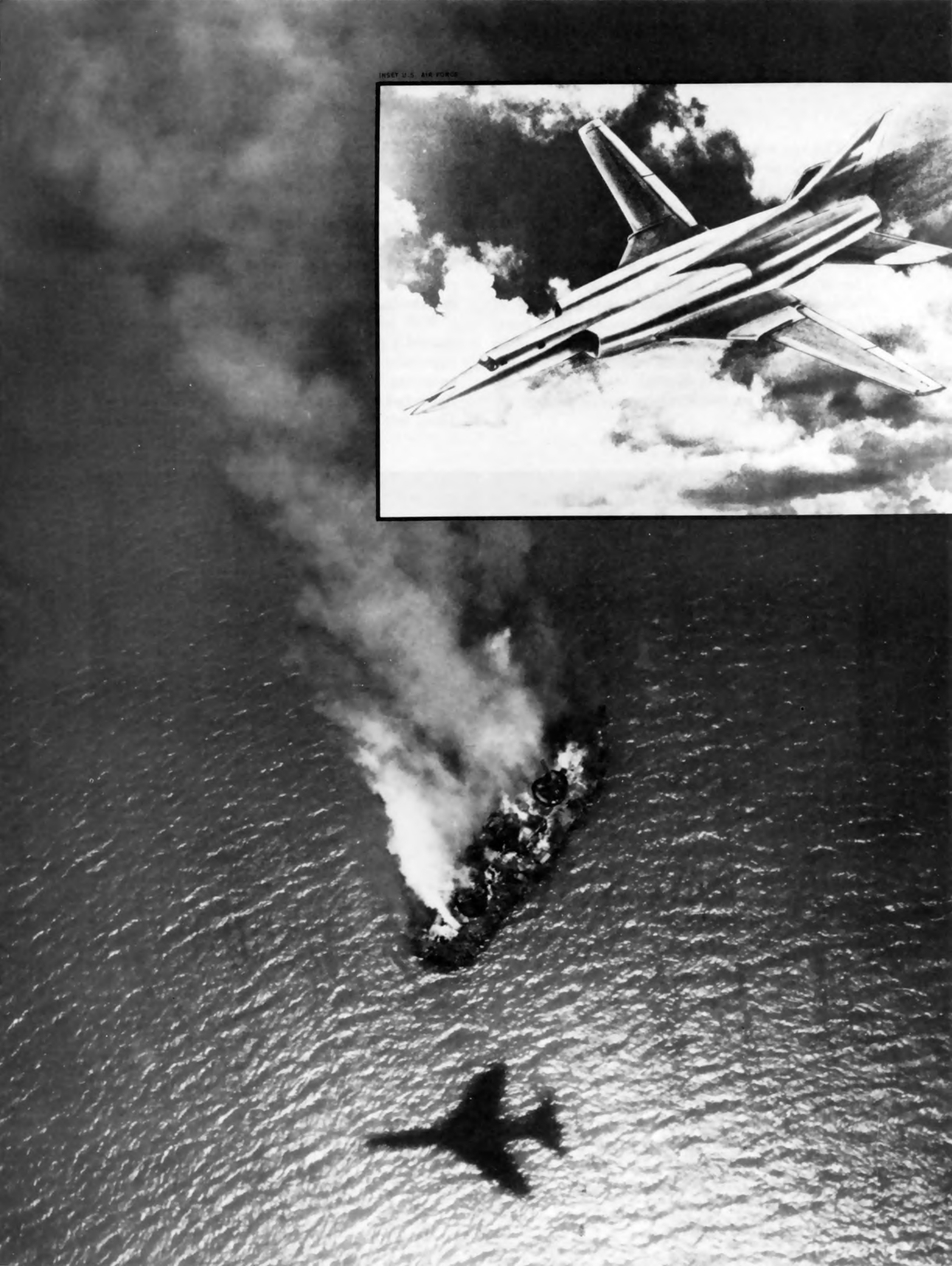
Until recently, Soviet Naval Aviation was primarily a defensive force. But the addition to its arsenal of the potent Backfire bomber has extended its offensive capability far beyond the Russian homeland. Because of its long range and the striking power of antishipping missiles, the Backfire could seriously hamper Allied convoys moving to Europe in wartime, or it could require heavy commitment of vitally needed ships and planes to safeguard the convoys. Neither alternative is pleasant to contemplate.

If the past few years have witnessed an alarming growth in the Soviet naval threat, there has at least been a concurrent growth in public awareness that there is such a threat. The quality of this awareness often leaves something to be desired, however. A great many people seem to see the Soviet threat in terms of a fleet of cruisers steaming forth to engage our own in a missile duel, sinking aircraft carriers right and left as they chance to pass by them. Of course there are also many people, better informed (or perhaps simply less romantic), who understand clearly enough that the Soviet force of 250 general purpose (attack and guided-missile) submarines is a far more serious threat in purely military terms.

But surprisingly few people realize that there is a third prong to the Soviet naval trident. It is every bit as sharp, if not yet quite so long as that of the submarine threat. As Admiral James L. Holloway III said, in addressing the 1976 annual meeting of the Naval Institute: " . . . our deployed fleets must have the defensive strength to defend themselves against attacks of land-based air, because we are seeing more and more the development of long-range aircraft with anti-ship missiles as a threat which can develop rapidly and can extend to almost any spot on the globe."

Perhaps the principal reason for the lack of widespread awareness of the Soviet land-based naval air threat is that its principal offensive capabilities are of quite recent origin. While Soviet Naval Aviation *(Aviatsiya Voennon-morskovo Flota)* has had a substantial force of missile-armed bombers for more than a decade, these were largely Tu-16 Badgers whose restricted radius of about 1,700 nautical miles without refueling did not suit them very well to offensive action against most major sea-lanes.[1]

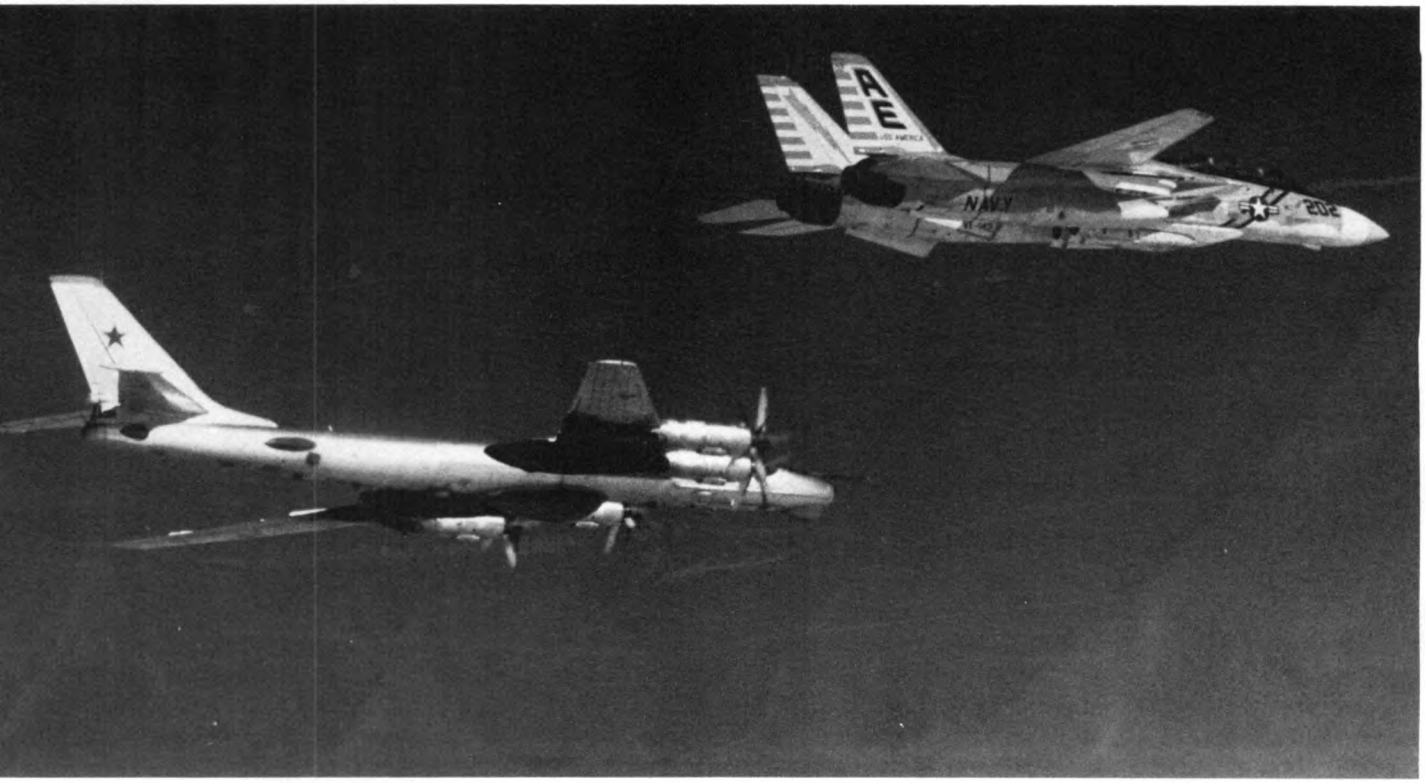
[1]For footnotes, please turn to page 35.


INSET U.S. AIR FORCE

This concentration on relatively short-range strike capability can only have been a matter of policy, for Soviet Long-Range Aviation force as a strategic aircraft with ample range to reach vital Atlantic and Pacific sea-lanes from Soviet homeland bases: the remarkable Tupolev Tu-20 (Tu-95 is the design bureau's designator) Bear. The Bear first joined the Soviet Long-Range Aviation force as a strategic bomber in 1956 and remains the backbone of Long-Range Aviation's intercontinental strike force. It has been officially estimated by DoD that the Bear has an unrefueled operational radius of 3,900 miles with a 25,000-pound payload. One version, the Bear B, carries an AS-3 Kangaroo nuclear missile for strategic strike.

When deliveries of the Bear to Soviet Naval Aviation began in the early 1960s, it presumably would not have been very difficult to have armed it with the AS-2 Kipper missile employed by the Badger C for antishipping strikes. But, according to published sources, Soviet Naval Aviation has employed the Bear only in the reconnaissance and surveillance role, providing targeting and mid-course guidance for missiles launched from other platforms.

Well into the 1970s, Soviet Naval Aviation remained a predominantly defensive force with a very impressive capability to strike surface forces approaching within 1,700 nautical miles of its bases. But it had only limited capability outside that range. Then, late in 1974, a new aircraft began appearing



COURTESY ATTACK CARRIER AIR WING SIX

A Soviet Bear D aircraft is intercepted by an F-14 Tomcat of Fighter Squadron 142. The Tomcat was operating from the USS America *(CV-66) during her Mediterranean deployment last year.*

on Soviet airfields: the Backfire.

The Backfire, a Tupolev design with a variable-sweep "swing wing," had been under development since the mid-1960s. According to published reports, the initial production version, Backfire B, is a highly capable aircraft, with a speed of Mach 2 at high altitude. Table 1 provides descriptive data drawn from unofficial sources.

There has been a great deal of public discussion, sometimes heated, concerning official estimates of

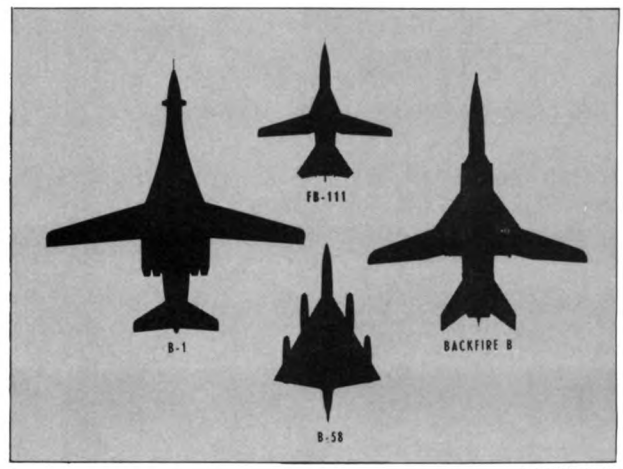
Backfire performance. This has apparently been engendered by the possibility that the aircraft, in addition to its unquestioned Eurasian-periphery and naval strike roles, might also be intended for strategic missions against the United States. One source, a column in *Aviation Week and Space Technology,* claims that there is a major divergence of official views on unrefueled combat radius, citing CIA/McDonnell Douglas estimates as low as 1,750 nautical miles and DoD estimates near 3,000 nautical miles.[2] There have been heated official condemnations of this column (although no explicit comment on the range estimates). It is possible that the seeming inconsistency actually is due to differing assumptions about flight conditions, with flight at low altitudes or supersonic speeds having an adverse effect on combat radius. Publicly released statements of various officials, including those in the CIA and the Department of Defense, about Backfire coverage in attacks on the United States imply an unrefueled high-altitude subsonic combat radius of approximately 2,500 nautical miles. Unofficial sources credit the aircraft with a 6,000 kilometer, or 3,240 nautical mile, radius.[3]

In the past, the Soviet pattern in introducing new bombers had always been to fill the needs of its Long-Range Aviation force first, and only then to start furnishing aircraft for naval aviation. The

Table 1 *Backfire Characteristics*

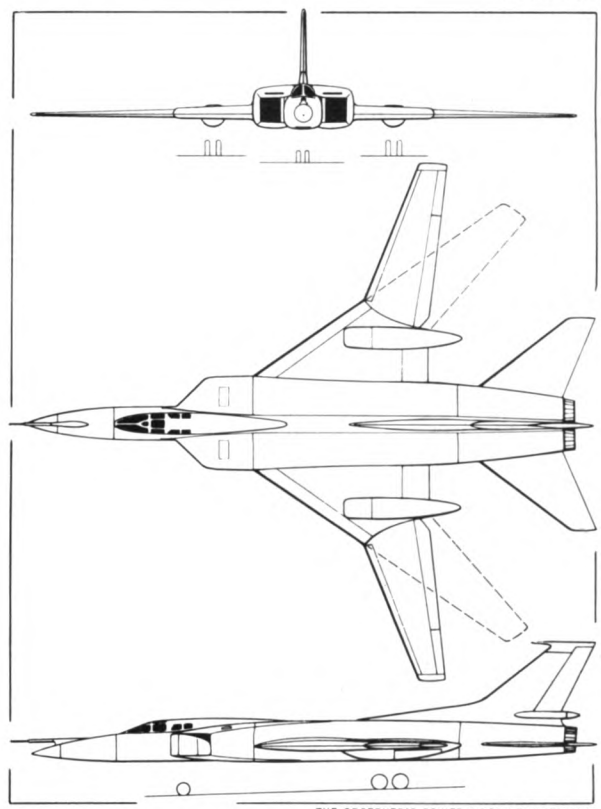
Maximum Gross Takeoff Weight	276,000 to 287,000 pounds
Operating Empty Weight	115,000 to 121,000 pounds
Maximum Span (20° sweep)	113 to 115 feet
Maximum Span (55° sweep)	90 to 92 feet
Length	138 to 139 feet
Maximum Speed at Sea Level	Mach 0.9 (600 knots)
Maximum Speed at High Altitude	Mach 2.0 (1150 knots)
Cruising Speed at High Altitude	Mach 0.82 to 0.85
Service Ceiling	59,000 feet
Maximum subsonic High Altitude Radius	(See text)
Armament: Two AS-4 or AS-6 cruise missiles, carried externally.	

Sources: Georg Panyalev, "Backfire—Soviet Counter to the American B-1," *International Defense Review,* October 1975, p. 639; William Green, *The Observer's Book of Aircraft* (London and New York: Frederick and Warne and Co., 1976), p. 200.



U.S. AIR FORCE

U.S. AIR FORCE



THE OBSERVER'S SOVIET AIRCRAFT DIRECTORY

Backfire is a significant exception, entering service with both air arms simultaneously. In May 1976, officials of the CIA testified before a congressional committee that a total of 80 Backfires had been produced to that date (including prototype and training aircraft) and that production was continuing at a rate of two and a half aircraft per month. It was estimated that a total of about 400 Backfires would eventually be produced. While these would be divided between long-range and naval aviation, all might be committed to naval missions under certain circumstances, since shipping attack is a collateral mission for Long-Range Aviation.

It is difficult to interpret this Soviet decision to supply the naval aviation force with the newest and most capable of long-range bombers as representing anything other than a determination to interdict the West's vital sea-lanes in event of war. Backfire's performance and equipment both argue a long-range offensive role. Homeland defense would not have demanded such a large, sophisticated, and expensive aircraft.

According to unofficial sources, Backfire carries a pair of either of two air-to-surface missiles, the AS-4 Kitchen or the AS-6 Kerry. Both have Mach 2.5 to 3.5 speeds and 150 nautical mile "operational ranges," although absolute maximum ranges appear to be substantially greater. The AS-6 is described as having an active radar homing system for terminal guidance, and thus presumably can be used as an antiship weapon with a nuclear or conventional warhead. It is also reported that the Backfire carries

Figure 1: *Chart of North Atlantic showing 2,650 nautical mile Backfire tracks from Murmansk*

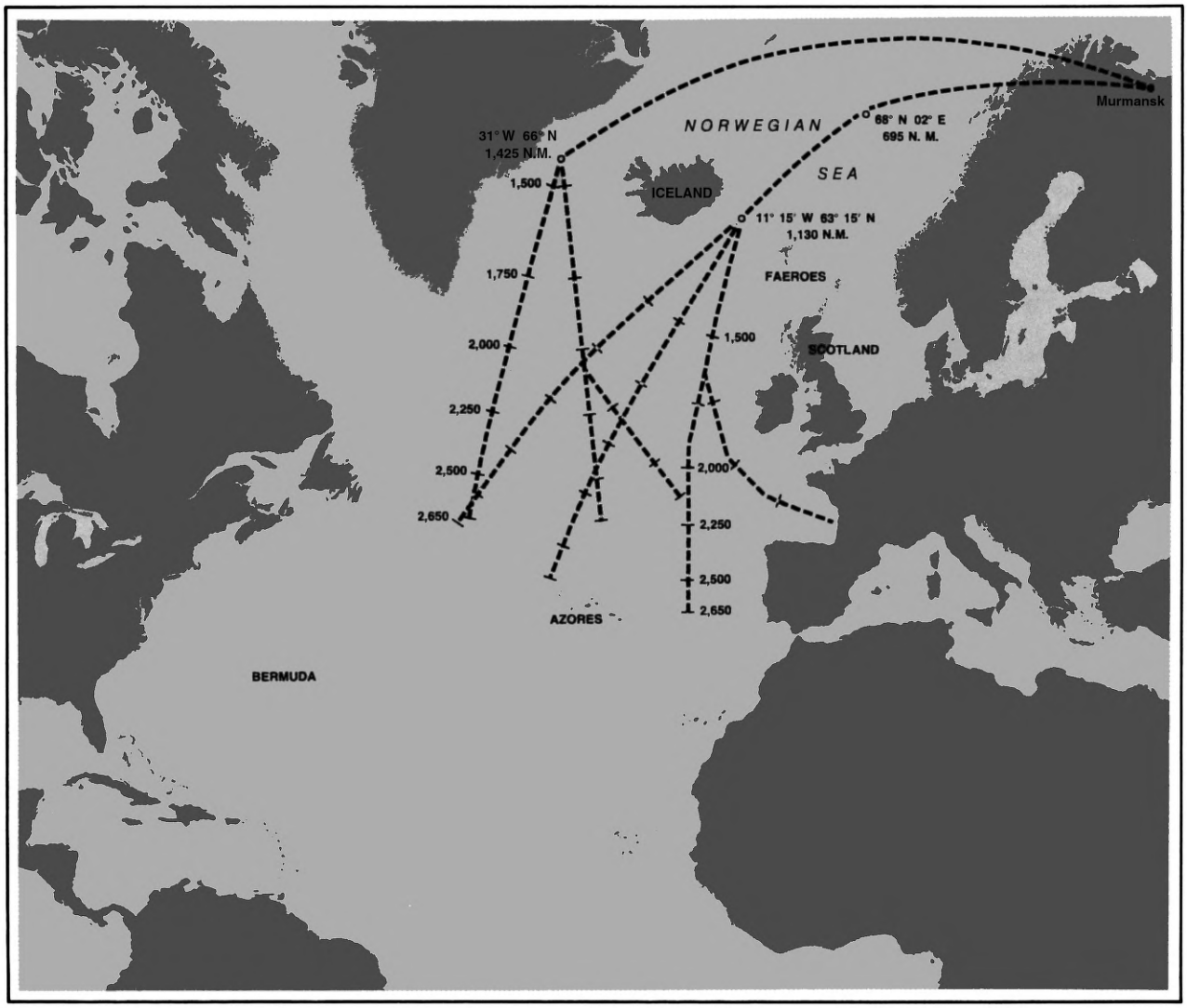
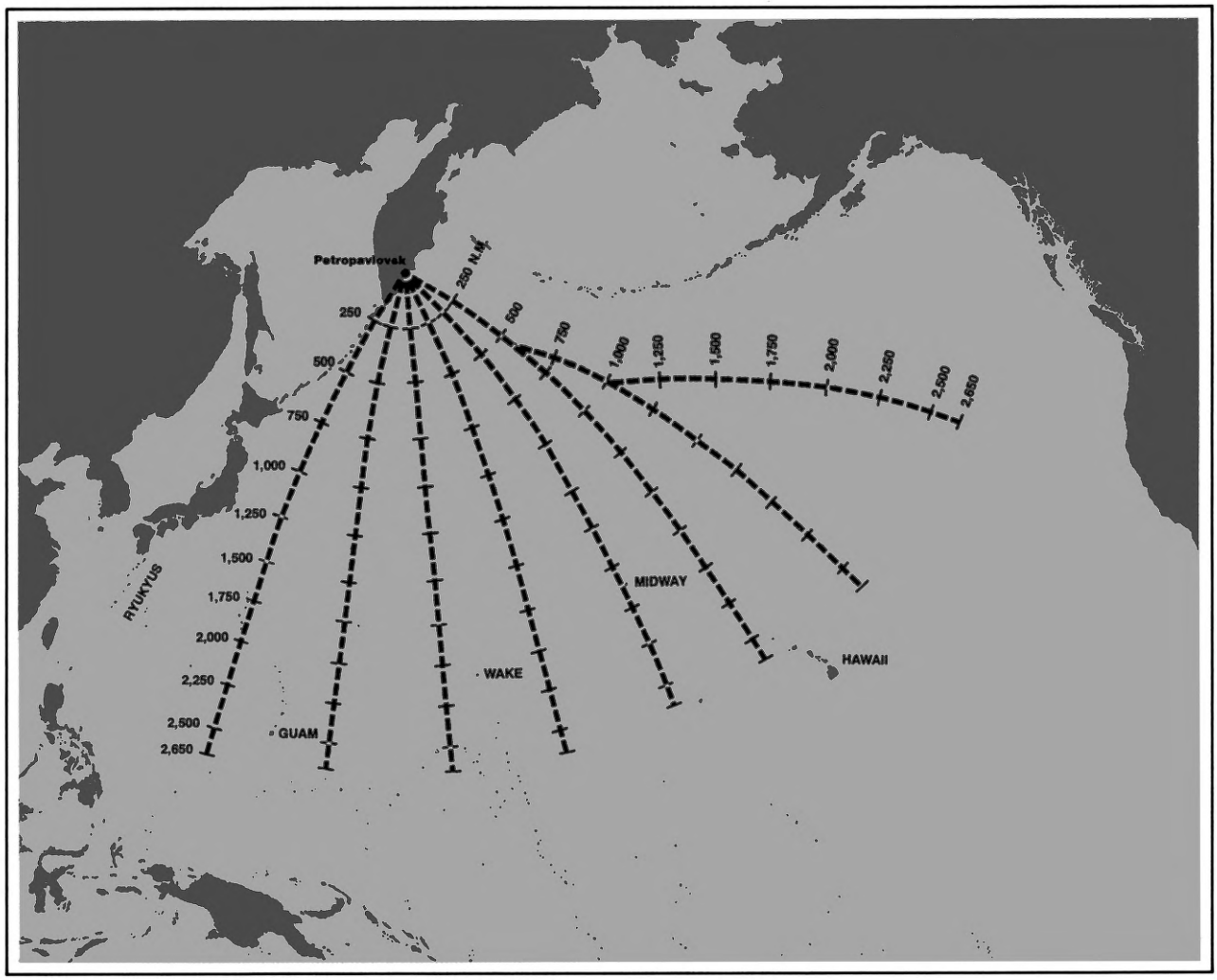


Figure 2: *Chart of North Pacific showing 2,650 nautical mile Backfire tracks from Petropavlovsk*



extensive passive and active electronic countermeasure systems to aid in defense penetration.

To see what the Backfire really means strategically, one must look at the map. Figures 1 and 2 show possible Backfire tracks superimposed upon charts of the North Pacific and North Atlantic Oceans. The tracks are marked off to indicate combat radius requirements. As discussed earlier, it appears that Backfire's unrefueled high-altitude subsonic radius must be 2,500 nautical miles or more. Actual range performance will depend upon a variety of factors, including flight profile, use of afterburners, reserves policy, weapon load and external fuel, use of inflight refueling, and pilot skill.

Looking at the charts, we see that it is impossible for ships to transit from the United States to either Northwestern Europe or to Japan without coming within reach of the Backfire. The great-circle routes lie almost wholly within potential Backfire coverage.

It is all too easy to envision what this might mean in, say, a war between the NATO nations and those of the Warsaw Pact. On the fifth day of the war—we shall imagine—a convoy bearing urgently-needed supplies and combat equipment is halfway from Hampton Roads to Le Havre. Under the protection of a heavy escort of submarines, frigates, and patrol aircraft, it has beaten off submarine attacks with relatively little loss. The Soviet high command is determined to prevent the arrival of these reinforcements.

Every few hours, the convoy's position on Moscow's maps is updated on the basis of satellite reports. As the convoy reaches a point midway between the Azores and Ireland, a force of 40 Backfires is launched from bases near Murmansk. The aircraft do not attempt to fly in close formation,

relying on their inertial and satellite navigation systems to bring them together at the rendezvous point.

The bomber stream is escorted out past the Norwegian coast by Mikoyan MiG-23 Flogger fighters. Once well out over the Norwegian Sea, the fighters depart, and the bombers turn south, to pass midway between Scotland and Iceland. The Backfires fly in a loose stream at their optimum cruise speed of just under 500 knots, climbing as they burn down their fuel loads. As they near the gap between Iceland and the Faeroes, they dip down to 8,000 feet to avoid any possibility of radar detection. Once clear, they climb again to their optimum cruising altitude, a little below 30,000 feet.

Moscow transmits a revised aircraft rally point, based on latest satellite and submarine reports. Some aircraft fail to appear, for one reason or another, but 36 Backfires meet and form up for the run-in and attack. Following their leader, still keeping radio silence, they select full afterburner on their twin NK-144 turbofans, climb to 45,000 feet, and accelerate to 1,000 knots or more. A few minutes later, the leader breaks radio silence. The convoy is in sight on the radar; he orders his formation to turn 20° to port in order to intercept.

At virtually the same moment, the SPS-49 air-search radar of one of the screening *Oliver Hazard Perry*-class frigates (FFG-7) registers the massive raid at a range from the convoy center of 250 nautical miles. With the radar operator calling jamming strobes all over the scope, and no IFF (identification, friend or foe), no one has any doubt about the raid's identity or intent. But what can be done about it?

Within six minutes, the Backfires have identified their targets and have set their missiles. The range has closed to 150 nautical miles, and the missiles are released. The Backfires turn to return home, with a few of their number remaining within radar range long enough for damage assessment.

Some of the missiles fail to perform as intended, but more than 60 (each plane carries two) approach the convoy in a space of minutes. The guided-missile frigates among the escort belch Standard SM-1 missiles until their foredecks are burnt black, but they can get only a fraction of the AS-6s. More than 30 survive to plunge into convoy ships. Several ships are sunk, and several more have much of their vital cargo destroyed.

The Backfire force does not get home unscathed, of course. Alerted by reports from the convoy, NATO interceptors based in Iceland and Scotland await the bombers along their return route. With support from long-range Soviet interceptors, heavy use of their own electronic countermeasures, and a high-speed dash to minimize exposure time, the bombers break through, but only after three are lost. It is not a cheap victory for the Soviets, but it is a victory all the same. (Had the bombers thought it safer, they could have gone back between Iceland and Greenland, refueling if needed over the Norwegian Sea.)

The details of this scenario are, of course, purely imaginary. There seems little, however, to prevent the Soviets from translating it into practice, at least in broad outline. Is there anything the United States and its allies can do to protect our vital sea-lanes against this threat?

In trying to answer the question, let us concentrate on convoys and non-carrier naval forces. The general principles of carrier force defense against air attack are well known, and details of effectiveness against Backfire cannot usefully be discussed in an unclassified article.

One suggestion would be to route shipping well south, turning northward only when in range of land-based fighter protection. The delays incurred through circuitous routing would be costly but probably tolerable—if the scheme worked. Unfortunately, it seems questionable whether the land-based fighters can really provide protection without an inordinate commitment of resources.

If the fighters are to be kept on strip alert, the problem is one of providing adequate warning time. In order to protect the convoy, the fighters must engage the Backfires before they reach the 150-mile missile-release line. Even if the convoy hugs the coast quite closely and the protecting fighters leapfrog from airfield to airfield, in order always to be at the closest one, they can scarcely have less than 150 nautical miles to fly to make the intercept. Allowing for engine start, takeoff, climb, and flyout, it would seem that even the fastest of fighters would need some 10 to 12 minutes' warning.

In 12 minutes, a Backfire can fly something over 200 miles, so detection will have to be made 350 miles out from the convoy. This would seem to imply a need for an airborne early warning radar aircraft—such as the Grumman E-2C Hawkeye or the Boeing E-3A AWACS (airborne warning and control system)—or a number of picket ships. If the convoy is more than 50 miles or so from the fighter strip, the warning time requirements will be increased proportionately, with resulting extension of the area which must be kept under surveillance.

If adequate warning could not be provided, then it would be necessary to have the fighters serving as combat air patrol (CAP) over the convoy. But to do any serious damage to a large Backfire raid would require perhaps six rather sophisticated missile-

entire 500-mile gap between Scotland and Iceland.

But if blocked between Iceland and Scotland, the Backfires have the option of transiting the Denmark Straits, between Iceland and Greenland. Flying this longer route, they would not be able to close off access to Europe by the more southerly sea-lanes—unless they were refueled in flight. But General Brown's posture statement indicates that Soviet Naval Aviation possesses a force of about 100 Badger tankers and that, "The introduction of BACKFIRE into naval aviation creates a potential requirement for a new tanker to support extended range missions." Depending on the capabilities of these tankers, it would seem that air refueling might extend the Backfire's radius by as much as 1,000 nautical miles—ample to permit full interdiction of the European sea-lanes via the Denmark Straits. In order to close off this route, it would be necessary to maintain a second AWACS orbit. Thus, the forces required to block Backfire entry into the North Atlantic begin to seem rather substantial: a squadron, say, of high-performance, long-range interceptors (the F-14 would appear ideal) each in Iceland and Northern Scotland plus however many E-3As are needed to keep two airborne on station. (Commercial 707s fly about one-third of the time, but the E-3A's complex avionics would probably have a deleterious effect on its flight availability.)

An alternative approach would be to try to counter the Backfire with carriers. Probably one carrier each in the Iceland-Faeroes gap and the Denmark Straits would be sufficient. The survivability of carriers in such positions seems questionable, however. The Soviets would be able to throw everything but the kitchen sink at them, and the Soviet submarines would descend in force.

In short, the options in the Atlantic appear to be:

- Tie up a lot of very valuable assets trying to defend convoys (and naval forces) one by one
- Tie up a lot of valuable assets trying to keep the Backfires out of the Atlantic altogether.

In the Pacific, the options look even less attractive. The Soviet base at Petropavlovsk offers almost unrestricted access to the open sea. There are no nasty allied bases sitting astride the flight tracks. With in-flight refueling there is virtually no point in the North Pacific which Backfires cannot reach. The southerly route from San Francisco to Japan stretches 7,500 nautical miles, and even that offers little security against air-refuelled Backfires. When or if the convoy does finally reach the questionable shelter of the Ryukyu Islands, south of Japan, one finds that airfields for protecting fighters are rather far between.

Trying to blockade Petropavlovsk with carriers seems to be a very questionable proposition at best. At least three or four carriers would be needed—assuming they stay beyond range of tactical strikes from Petropavlovsk—and, again, they would be very much exposed to attack.

For the moment, the Soviets probably do not have enough Backfires to deploy a significant force to the Pacific. As their inventory builds, however, it will become increasingly difficult to envision wartime resupply of Japan without direct carrier protection.

If experience is any guide, there will be no shortage of explanations that the Backfire is really not a threat, nor of simple schemes to meet the complex problems it poses. It is easily predictable that the most prevalent of the easy solutions will be that convoys and other forces carry their own air defenses, in the form of V/STOL (vertical or short takeoff and landing) aircraft.

Unfortunately, the only existing Western V/STOL which resembles a fighter in any way is the Hawker Siddeley/McDonnell Douglas AV-8 Harrier. The Harrier is a remarkable aircraft with many wonderful abilities, of which long-range air intercept is definitely not one. Quite aside from being strictly subsonic, the Harrier has no air intercept (AI) radar and hence no ability to carry any armament effective beyond visual range. Even if an AI radar and suitable missiles could be carried without hopeless compromise to the Harrier's preformance (the aircraft is scarcely larger than the McDonnell Douglas A-4 Skyhawk) one would still face the same dilemma we encountered earlier: either one must have airborne early warning aircraft to give adequate warning for the fighters to scramble, or one must have a substantial combat air patrol.

There is no V/STOL early warning aircraft. One could probably be developed—given the better part of 15 years and a billion dollars—but there is no reason to suppose that it could be any smaller than the DC-3-size Grumman E-2C which now graces carrier decks. Several of these, plus perhaps a dozen Harriers would call for a good-sized ship to carry them.

Given the Harrier's rather restricted flight duration, it would probably take something like six aircraft on board ship for each combat air patrol station. With six stations, this would mean some three dozen aircraft altogether—again, requiring quite a good-sized ship. And, again, the Harrier in its present form is not suitable for such missions in any case.

It would probably be possible to develop a V/STOL fighter with good intercept performance (given,

BOEING AIRCRAFT CORP.

U.S. AIR FORCE

One solution to detecting Backfire raids would be the use of Air Force E-3A AWACS planes. The diagram at left indicates the broad scope of coverage by the AWACS.

armed interceptors (although this might be scaled down to four or so in the case of the Grumman F-14 Tomcat with its multiple-engagement capabilities). And to keep this number of fighters on continuous CAP would require commitment of the better part of an air wing.

In either case, we seem to be dealing in assets NATO can ill afford to spare from other requirements, particularly when account is taken of the possibility that several convoys might require protection simultaneously. Of course, a carrier might provide quite effective escort against Backfire attack. But here again, we are using an asset which will be urgently needed elsewhere. There is also the consideration of the risk involved to the carrier. One great advantage which carrier escort would have over land-based fighter cover, however, would be the removal of the restriction to close in-shore tracks, with their exposure to submarine attack and mines.

At this point, some readers will object that the potential of land-based fighter cover is being slighted. It is not really necessary to make the intercept before the Backfires launch their missiles, it can be argued. Even the prospect of substantial casualties after launch would be enough to deter attack.

Leaving aside inherently metaphysical calculations of what sorts of losses Soviet Naval Aviation might consider acceptable, this objection can be met on purely physical grounds. For, after the Backfires have made their missile launch, they will turn away, involving the interceptors in a tail-chase. To catch a Mach 2 aircraft before your own fuel runs out—especially after you have been flying in maximum afterburner for eight to ten minutes just to get to the starting line—requires performance of a very high order. Such aircraft do exist—the MiG-25 Foxbat and Lockheed YF-12A are two—but not in NATO squadrons.

If the cost of defending convoys individually seems excessive, the NATO nations might try another approach: cut 'em off at the pass. It has already been observed that passage of the Iceland-Scotland gap involves serious dangers to a Backfire raiding force (at least as long as NATO manages to hang onto Iceland). If suitable warning could be provided, interceptors based in Iceland and Scotland could take a serious toll of any bomber force, both outbound and inbound.

A suitable means to provide the warning appears to exist—Congress and the European NATO nations willing. It is the E-3A, the airborne warning and control system (AWACS), a Boeing 707-320B airframe fitted with an enormous, powerful Westinghouse radar and ranks of intercept-control consoles.

There do not seem to be any public discussions of radar coverage by the AWACS, but the fiscal year 1977 posture statement of General David C. Jones, the Air Force Chief of Staff, provides a radar scope photo taken onboard a high-flying AWACS prototype, not far from Norfolk, Virginia. The hundreds of radar returns displayed run from the southern tip of South Carolina to upstate New York, a span of 700 nautical miles. Thus, it appears safe to conclude that a single AWACS orbit could give coverage over the

again, 15 years and a billion dollars). But if the idea is to achieve deck-launched intercepts on the basis of shipboard radar warning, then the performance requirements are breathtaking.

Perhaps a more attractive alternative, if one is willing to wait for new developments, would be a long-range, surface-to-air missile system. There certainly should be no particular problem in designing a ramjet missile which can get out 150 nautical miles in less than five minutes. The Talos, introduced in the 1950s, offers nearly that level of performance. Targeting, command-control, and guidance would present formidable challenges, particularly in light of the need for high firepower and the likelihood of electronic countermeasures opposition.

One possible shorter-term developmental approach would be a long-endurance aircraft combining the warning and missile platform functions. In this concept, bomber or transport type airframes would be outfitted with an existing type of airborne early warning radar (such as the APS-88 of the E-1B or the APS-125 of the E-2C), one or more AWG-9 fire control systems, and a number of AIM-54 Phoenix missiles. (The AWG-9/Phoenix is the air-to-air weapon system of the F-14.)

The long-range and multiple target capability of the AWG-9/Phoenix system would permit even a subsonic aircraft to make a number of intercepts before the Backfires could launch. Use of a large aircraft with long range and high endurance, such as the Lockheed P-3 Orion now used for antisubmarine patrols, would permit escort of convoys far at sea, without tying up a carrier. Such a warning/missile aircraft might also have value in interception of Backfires on the way to and from their strikes, particularly in the Pacific. By sticking to existing types of airframes and systems, one would tend to reduce development cost and time. The aircraft would be expensive, however, and long transits to mid-ocean stations would eat into productivity.

It is clear that Admiral Holloway's concerns about the land-based air threat are amply supported by the cold facts. The heavy investments the Soviets are making in offensive, long-range antiship aircraft speak eloquently on their intentions. The United States and its allies are faced with a number of complex choices in deciding how to meet this threat. These choices must be analyzed and resolved, quickly and objectively, if we are to continue to have confidence in our ability to use the seas for essential defense purposes.

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[1] Radius as used here refers to one half the range of the aircraft, that is, the distance it can fly to an objective and then get back to its point of origin with a minimum of fuel remaining.

[2] "Washington Roundup," *Aviation Week and Space Technology*, 13 September 1976, p. 13.

[3] Georg Panyalev, "Backfire—Soviet Counter to the American B-1," *International Defense Review*, October 1975, p. 639; William Green, *The Observer's Book of Aircraft* (London and New York: Frederick and Warne and Co., 1976) p. 200.

Mr. O'Neil was awarded his bachelor's degree in mathematics by UCLA in January 1960, and immediately reported to the U.S. Naval Officer Candidate School. Upon commissioning, he was assigned to USS *Vesuvius* (AE-15). After two deployments as navigator, he was transferred to U. S. Navy Electronics Laboratory, San Diego, where he worked on NTDS developments. Following release from active duty (as a lieutenant) in 1964, Mr. O'Neil was hired as an associate by Planning Research Corp. of Los Angeles, California. In 1966 he moved to Bissett-Berman Corp., Santa Monica, California, as a Senior Scientist and Project Manager, working principally in ASW programs. He was hired in 1967 by the Advanced Marine Technology Division of Litton Systems, Inc., in Culver City, California, where he became a section manager responsible for a variety of definition efforts for conventional and advanced ships. Throughout this period, he attended UCLA and was awarded his master's degree in quantitative methods in 1968. In 1969, Mr. O'Neil returned to government service as a civilian in the Office of Program Appraisal, on the staff of the Secretary of the Navy, acting as a researcher and advisor on ship and weapon system programs. Since 1973, he has held an appointment as a staff specialist in the Office of the Director of Defense Research and Engineering, where he has responsibility for overseeing all Department of Defense development of Navy general-purpose force ships, ASW and patrol aircraft, exotic vehicles, mines, and mine countermeasures systems.