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get, or risking snorting to charge his
batteries.
The nuclear boat is not much better
off. If it proceeds slowly, the reactor
pile (which takes time to build up
temperature) must be kept hot in case a quick turn of speed is needed. This means that the reactor cooling pump must be kept running at full speed to avoid a melt-down of the pile. The reactor cooling plant,? although better insulated on later Soviet designs, is still noisy and noise is lethal to submarines.

If the submarine escapes the patrol aircraft, the next screen encountered will be long-range helicopters of the Sea King type. These will range some 50 to 100 miles from the convoy, using active dunking sonar as the main sensor. The submarine crews must now pick out their target. Inside the helicopter screen, ASW frigates are waiting. Outside the helicopter screen long-range aircraft are patrol-ling. From leaving the home port the submarine has found its way by sonar and inertial navigation. At this point the submarine must use its various aids to locate targets. It is here that the submarine is most vulnerable. If it slows down to listen for the con-voy, it may well get left behind and, if it dashes then stops to listen, it is noisy. If radar is used it is picked up on ESM. Periscopes will also be picked up on radar. If the submarine does nothing, it has failed just as surely as if it was sunk.

Some Soviet submarines do not need to penetrate as far as the heli-copter screen. Equipped with surface-to-surface SS-N-7 cruise missiles, with a range of 25 miles, these submarines can stand-off and launch their mis-siles. Some types must surface to launch while others can launch from shallow depth. The SS-N-3 missile requires mid-course guidance from either the parent submarine or from a suitably equipped aircraft.
Early maritime patrol aircraft were limited in speed and sensor ability but usually had adequate endurance. Contemporary aircraft are mostly turboprop-powered with the exception of the Nimrod and Viking. As elec-tronic sensors developed, the main problem was no longer one of speed, warload or endurance, but increased workload for the crew. Each new device or development increased the flow of data. The crew had to evaluate incoming data quickly and to filter out what would be of most use. In-undated with data, crews could study only occasional samples. The most skilful crews were those that picked the correct data and interpreted it quickly and accurately.
The advent of reliable, lightweight computers has relieved crews of the sheer drudgery of manual plotting and sliderule work. All sensor, navi-gation, communication and aircraft systems are now handled by com-puter. Whereas in the pre-corriputer era the tactical crew spent 85 per

The Westland/Airospatiale Lynx is in extensive service with shipborne ASW forces. The French Navy version, depicted here, shows the main wheels toed-out for a deck landing

Helicopter ASW
HELICOPTEKS provide short-range anti-submarine protection for a fleet or convoy and a large number of ship classes carry one or two ASW helicopters. Existing helicopters tend to use an active dipping sonar to detect submarines but new aircraft, under develop-ment or in preliminary design, rely on sonobuoys. By using passive buoys to progressively close in on a target it is possible to remain covert until the attack is launched.

The Royal Navy's Westland Sea King ASW helicopter uses a Plessey Marine Type 195 dunking sonar. Pulses of acoustic energy are transmitted by the probe and the received echoes are presented on two calibrated CRT displays and through headphones. Although the Westland Lynx is primarily a fast weapons platform in Royal Navy service, French Navy air-craft are equipped with a CIT-Alcatel active/passive dunking sonar which weighs 250kg when installed.

The Royal Navy has selected the Marconi Avionics lightweight acoustic processing and display system (Lapads) for its Sea Kings. This receives and processes sono-buoy signals, presenting the infor-mation on a CRT and hard copy display. Lapads, wLich weighs only 55kg ia its Sea King form was developed privately by the com-pany using AQS 901 experience. A developed version of this system will equip the Westland WG.34 Sea King replacement.
The Sikorsky SH-60B Lamps III helicopter can be regarded as a remote extension of the ship's sensors. Heart of the system is a secure data link along which infor-mation is passed from the heli-copter radar, acoustic and ESM sensors to the ship for processing. Should the helicopter be required to drop below the horizon, the crew can take over control of all sensors using onboard processors. Taomson-CSF has developed sonobuoy-based ASW systems for the Aerospatiale Puma and Dauphin helicopters. The basic configuration allows the helicopter to process four omnidirectional passive sonobuoys or two direc-tional Bifar passive buoys. Two Gass or one directional Dicass attive buoy can be handled. Dwarf sonobuoys are used and the pro-posed Puma system, which in-cludes a hard copy recorder, weighs some 120kg. The Dauphin system, with CRT display only, weighs 90kg.

Anti-submarine aircraft also shadow surface vessels. This Royal Air Force Nimrod is seen inter-cepting a Soviet Kotlin class destroyer ,