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CAPITALIST STATES' RECENT,

30 JUNE 1980 FUTURE SUBMARINES DESCRIBED 1 OF 1

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30 June 1980

USSR Report

MILITARY AFFAIRS

(FOUO 13/80)

CAPITALIST STATES' RECENT, FUTURE SUBMARINES DESCRIBED

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[Annotation, table of contents, last two chapters, conclusion and bibliography from the book, "Razvitiye zarubezhnykh podvodnykh lodok i ikh taktiki" [The Development of Foreign Submarines and Their Tactics] by Lev Petrovich Khiyaynen, Voyenizdat, 15,000 copies, 150 pages]

[Text] The mission of the submarines of capitalist states and the tasks they performed in world wars I and II. Change in their tactics as a function of the development of tactical and technical characteristics. The influence of their activity on the development of other naval forces. The construction and modernization of submarines of the principal capitalist countries in the postwar period and developmental trends.

Written in accordance with information from the open domestic and foreign press.

Intended for VMF [Navy] personnel and a broad group of readers who are interested in the development of submarines and their tactics.

Contents

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The Submarines of the Capitalist States After World War II

The mightiest power of the capitalist world is the United States. It has created powerful armed forces and is actively promoting the creation of the armed forces of its allies. The nuclear weapon, which was tried at the end of World War II on the Japanese cities of Hiroshima and Nagasaki, has become the USA's main offensive weapon.

American specialists consider that navies are capable of performing the following tasks in a nuclear war:

1. Destroying strategic and industrial targets and administrative centers on the enemy's territory.

2. Destroying his oceanic and sea communications.

3. Landing troops on his territory.

4. Defending its own territory from strikes by the enemy's navy and its landing forces.

5. Defending its own oceanic and sea lines of communication.

6. Defending its own nuclear-missile strike forces that operate in the oceans and seas.

U.S. and NATO strategists assume that the navy's submarines will have to participate in an all-out nuclear war, in a war with the limited use of nuclear weapons, or in wars in which the nuclear weapon will not be used. In conducting a war without the use of nuclear weapons, the U.S. Navy, maintaining its nuclear forces in the highest degree of readiness at sea, probably will be able to execute tasks 2-6 completely. Task 1 can be performed in a limited way with the forces of carrier aviation. The United States is gradually reducing the number of nuclear warheads on its territory and is increasing the number thereof on ships. Thus, it is trying to disperse strategic nuclear weapons and, in case an all-out nuclear war starts, to safeguard its own territory from nuclear strikes.

In considering that a nuclear war can be started suddenly, the Americans are already, in peacetime, maintaining their nuclear forces in high readiness, for which purpose a large portion of the SSN's are constantly at sea.

Specialists of the main capitalist countries consider that submarines supplied with modern equipment and weaponry can accomplish the strategic tasks set for their navies during the postwar period more effectively and at less expense. Research connected with increasing submerged speeds and the range and duration of underwater navigation, diving depth, and the operating range of underwater means of observation, communications and weaponry, as well as the precision of marine navigation, has been going on in these countries since the end of the 1940's.

The main task of many US submarines built during the war and right after the war was the testing of new equipment, weapons and hulls, in order to obtain the data necessary for later submarine construction.

The year 1955 became a turning point in the history of submarine construction abroad: the first nuclear submarine, the "Nautilus" (U.S.), went into operation. A qualitative leap in the development of submarines by the capitalist states had occurred. First came the construction of experimental and then of combat SSBN's armed with ballistic missiles, ASW missiles and torpedoes, and of nuclear-powered attack submarines armed with torpedoes, ASW missiles and mines.

The SSBN's of the United States, Great Britain and France, in the opinion of foreign specialists, are designed to destroy important strategic targets on the enemy's territory (that is, to execute the navies' main offensive task in an all-out nuclear-missile war). It is these ships, using their secrecy, great navigational range, operational independence, mobility and relative invulnerability that are the best carriers of ballistic missiles capable of inflicting nuclear strikes on the enemy. In the United States, SSBN's are included in the strategic mission forces, along with intercontinental missiles and strategic aviation.

In the opinion of U.S. specialists, SSBN's have enabled the participation of their navy, along with other forces, in the peacetime "strategic deterrent" forces that will be effective if a probable aggressor knows that his proposed enemy has at his disposal sufficient means for a retaliatory strike and that these means will not suffer seriously from a surprise strike. One of the basic requirements laid on a delivery system is invulnerability. This is provided by dispersion, defensive measures, secrecy, maneuverability, survivability and defensibility, and also by long-range observation and early warning. The sea-based underwater Polaris-Poseidon strategic nuclear missile system already created in the United States and the Trident* system that is being created answer this requirement most completely. The SSBN's of these systems should be in constant readiness to inflict a pre-emptive nuclear-missile strike.

Nuclear-powered attack submarines are intended for destruction of the enemy's underwater and surface ships, the destruction of his oceanic and sea communications, the defense of SSBN's and large surface ships operating in the oceans, particularly the undersea protection of aircraft carriers, the conduct of reconnaissance, and support of the fleet by performing other tasks.

The main task of nuclear-powered attack submarines of the United States and Great Britain is considered to be to deal with the enemy's submarines, since they will be more effective for this purpose and the sole means for performing this mission under the polar ice.

The construction of combat diesel submarines ceased in 1960 in the United States and in 1967 in Great Britain, and it was to end in France in the 1970's.

The appearance of SSN's in the navies of the United States, Great Britain and France and the cessation of the construction of diesel submarines is explained by the fact that, in the opinion of these countries' specialists, nuclear submarines that meet the requirements of the times can operate effectively in performing practically all the main tasks of their navies at present and in the foreseeable future, and diesel submarines no longer meet these requirements.

*In the United States, a weapons system is a complex of elements capable of performing a definite mission. The Polaris-Poseidon system includes Polar and Poseidon ballistic missiles and their carriers--SSBN's of the "Lafayette," "Ethan Allen" and George Washington" classes. Auxiliary systems that support the fulfillment of these tasks by submarines include communications, control and servicing resources.

The Trident system includes the Trident ballistic missile, "Ohio" Class SSBN's that are being built, and the appropriate auxiliary systems.--Author's note.

Aside from combat submarines, the U. S. Navy has experimental submarines, both nuclear and diesel, for studying problems connected with the creation of deepwater, high-speed, low-noise SSN's.

The Main TTE's [Tactical and Technical Characteristics] of Submarines Built after 1954

The main TTE's of combat diesel submarines of postwar construction (table 6) have experienced essentially no change in comparison with the TTE's of the submarines of World War II.

Displacement has increased by 21 percent, operational depth by 19 percent. Underwater speed (except for the Barbel and Albacore submarines) remains unchanged, as do the cruising range and time at full speed. The reason is the limited capacity of their batteries. The increase in submerged speeds of the Barbel and Albacore to 25 and 30 knots for a short period was obtained by improving the hull configuration, increasing the power of the electric motors to 3,100 hp, and installing a single screw.

The TTE's of SSN's greatly exceed those of diesel submarines. Nuclear power has enabled submarines to solve all the tasks peculiar to them, by cruising under water without surfacing. This provides for secrecy of operations and the surprise element of strikes. Nuclear and missile weapons enable SSN's to operate not only against ships and craft at sea and at bases, but also against enemy surface targets located both in coastal regions and in the depths of enemy territory.

The displacement of SSN's is almost triple that of the largest diesel submarines. The increase in displacement is explained by the increase in weight and size of the power plant, weapon systems, complexes and systems for observation, communication and navigation, hulls (an increase in strength), and the equipment that provides for habitability. The engine power of SSN's is 2.5-fold that of diesel submarine engines. The SSN's' engines for running submerged or surfaced have been steam turbines, and the nuclear reactors the energy sources. The SSN's' nuclear fuel reserves enable them to run for several years without recharging the reactors, to have high underwater speeds and to refrain from surfacing. This distinguishes them radically from diesel submarines.

The weapons have undergone major changes. SSBN's have received, instead of artillery weapons with a firing range of less than 10 km, solid-propellant Polaris and Poseidon ballistic missiles that are intended for the destruction of surface targets and are launched from below the surface. The Polaris A-3 has a flight range of 4,600 km and it has a separating nuclear payload that splits up into three warheads with a total yield of 1 megaton; the Poseidon, with a flight range of 5,200 km, has a payload that splits up into 10-14 warheads with a power of 50 kilotons each. Each separate final warhead that emanates from the initial payload should fly to its own target on a separate trajectory, greatly complicating antimissile defense.

Table 6

Main Tactical and Technical Elements of Some Submarines of the Main Capitalist States, 1945-1977

Type of boat, years of construction, and country	Displacement, tons submerged / surfaced	Engines (hp)	Armament	Observation, communications equipment, submerged	Speed (kt)	Operating depth (m)	Navigation range (miles)	Endurance submerged (days)	Crew
Nuclear-powered missile-armed submarines									
Lafayette 1963-1967 USA	8,250 / 7,250	15,000	16 Polaris-Poseidon system ballistic missiles; 4 NTA's 533-mm	GAK	23 / 18	270	400,000 without reactor refueling	60	2x140
Resolution 1968-1969 Britain	8,400 / 7,500	•	16 Polaris A-3 system ballistic missiles; 6 NTA's 533-mm	GAK	25 / 20	•	•	•	2x141
Redoutable 1971-1976 France	9,000 / 7,900	15,000	16 Polar type ballistic missiles; 4 NTA's 550-mm; 18 torpedoes	GAK	25 / 20	220	•	•	2x135
Nuclear-powered torpedo-armed submarines									
Los Angeles 1976 USA	6,900 / 6,000	15,000	4 torpedo tubes, 533-mm in mid-hull on the sides; Subroc, Harpoon rockets; MK-48 torpedoes	GAK and towed GAS	33 / 20	270	60,000	100	127
Swiftsure 1974 Britain	4,500 / 3,500		5 NTA's 533-mm	•	30 / •	•	•	•	97

Table 6 (continued)

Type of boat, years of construction, and country	Displacement, tons submerged/surfaced	Engines (hp)	Armament	Observation, communications equipment, submerged	Speed (kt)	Operating depth (m)	Navigation range (miles)	Endurance submerged (days)	Crew
Diesel-powered submarines									
Barbel 1959, USA	2,895/2,150	3,150/4,800	6 NTA's 533-mm	•	25/15	220	•/14,000[•]	•	77
Agosta 1976 France	1,725/1,450	4,600/3,600	4 NTA's 550-mm; 20 torpedoes	ShP; GL	20.5; (10 min)/10 (RDP)	•	350[4]/7,000[RDP]	45	50
Oberon* 1961-1967 Britain	2,410/2,030	6,000/3,680	6 NTA's 533-mm; 2 KTA's; 30 torpedoes	•	17/12	•	•/•	•	68
Diesel-powered experimental submarines									
Dolphin 1968 USA	925/700	1,650/(no engines for surface movement)	1 NTA 533-mm	Deepwater GA	12/•	900	•/•	•	22
Gymnaut 1966, France	•/3,800	620/2,600	4 ballistic missiles	•	10/11	•	•/•	•	70
Albacore 1953, USA	1,850/1,500	15,000/1,700	•	•	30/25	•	•/•	•	52
Nuclear powered experimental submarines									
NR1 1969, USA	•/400	•	•	•	•	1,000	•/•	30	7
Glenard P. Lipscomb (turbo-electric) 1974, USA	6,480/5,800	•	4 NTA's 533-mm; Subroc rockets; ASW torpedoes	•	25/•	•	•/•	•	120

Table 6 (continued)

Type of boat, years of construction, and country	Displacement, tons submerged / surfaced	Engines (hp)	Armament	Observation, communications equipment, submerged	Speed (kt)	Operating depth (m)	Navigation range (miles)	Endurance submerged (days)	Crew
Midget submarines									
SX506 • Italy	• / 70	• / 300 (RDP)	3 variants**	•	6 / 8.5	100	1,200[7]	12	5 + 8 swimmers

Comments:

1. Conventional designations:
   [TA--torpedo tubes]
   NTA--bow torpedo tubes.
   KTA--stern torpedo tubes.
   GA--sonar apparatus.
   GAS--sonar installation.
   GAK--sonar complex.
   ShP--underwater listening device.
   GL--echo-ranging sonar.
   [RDP--snorkeling]
2. Data in the numerator relates to the submerged condition, denominator data relates to the surfaced condition.
3. For diesel submarines, the speed and sea endurance submerged, using electric motors, is given for a new, completely charged storage battery and a clean hull.
4. A single asterisk denotes two-shaft boats, the others are single-shaft.
5. The maximum submerged depth of the "Redoutable" is 487.5 meters.
6. The "Glenard P. Lipscomb" is a midget submarine without a main reduction gear, and the maximum submerged depth is 1,000 meters.
7. Diesel submarines can go under water at full speed for an hour.
8. Double asterisks denote variants of the SX506 armament:
   --8 small (50-kg) mines plus two transporters with 1 large mine each;
   --6 large (270-kg) mines; and
   --2 torpedoes, MK-37 model 0 or 3.

Great Britain has the Slim ZUR [short-range antiaircraft missile], which is intended for firing from submarines at periscope depth against low-flying antisubmarine helicopters and airplanes. This is a two-state solid-propellant missile with contact and proximity fuzes and with a tracer. The warhead is high-explosive. The launch installation has six missiles. Firing range is 3 km. The weight is 14 kg. Angle of fire is 360 degrees about the horizontal and from -10 to +90 degrees about the vertical.

For destroying enemy submarines, U.S. submarines are armed with antisubmarine general-purpose Subroc rockets, and, for destroying surface ships and craft, Harpoon rockets that are released from torpedo tubes (table 7). The yield of the nuclear charge of Subroc rockets is 80-fold that of World War II torpedoes. Its flight range is 8-fold the range of the latter. Each nuclear torpedo submarine has up to six such missiles.

Modern torpedoes are intended for firing against both submerged targets (which was not the case during World War II) and surface targets. They have ordinary and nuclear charges. Torpedoes with a nuclear charge yield a TNT equivalent of 2.5 kilotons and can sink an enemy submarine when detonated at a distance of 915 meters from it, while in order to sink the same boat with an ordinary charge, detonation of a 2-ton charge at a distance of not more than 11 meters from its hull is required. The range of torpedoes has increased 4-fold. All modern submarine torpedoes have target-seeking apparatus and proximity fuzes.

The most modern torpedoes in the United States are the MK-48, the MK-45 (Astor) and the MK-45F (Freedom) general-purpose torpedoes. The MK-48 Model 1 torpedo began to arrive in the fleet in 1973. Serial production began in January 1975 of the MK-48 model 3 torpedo, which has two-way communication with the firing submarine, which receives data about the torpedoe's mechanical trajectory and the status of its on-board systems, and, after switching on the homing head, information about the target's maneuvers. The MK-48 is guided by the submarine's GAK [sonar complex] on frequencies of 2,000 and 5,000 Hz. The coordinates of the target and the torpedo and the course and speed of the firing ship enter the torpedo-firing computer complex, which works out the torpedo's course on this basis and provides for its encounter with the target.

The United States has active (MK-45F) and combined (active and passive) target-seeking (MK-48) systems, which have a reaction range of up to 1,500 meters on a frequency of 30-60 kHz. In the search mode, with homing, the MK-48 torpedo's trajectory at a running depth of less than 50 meters is sinusoidal, and at more than 50 meters it is helical. After target detection by the homing apparatus, control by wire ceases and the torpedo proceeds according to homing commands. Remote control provides a higher hit probability and enables time for preparing for the shot to be reduced.

According to data of the foreign press, all types of the U.S.'s submarine torpedoes will be replaced by the MK-48. By 1976 about half of the submarine's had already been armed with them.

Table 7

Basic Tactical and Technical Data for Certain Torpedoes and Hunter-Killer and Antishipping Rockets Launched from 533-mm Torpedo Tubes of Contemporary U. S. Submarines

Weapon (mission)	Explosive substance	Maximum running depth (m)	Speed	Guidance system	Radius of homer reaction (m)	Distance of torpedo run or rocket flight (km)	Weight (kg)
Torpedo MK-48 (general purpose)	Ordinary	914	50-60 kt	Active-passive homing and remote control	1,500	18	1,300
Torpedo MK-45 (general purpose)	Nuclear (10 kt)	200	40 kt	Remote control	●	11	1,000
Torpedo MK-45F	●	15	40 kt	Remote control and homing Mod. 0 is wire-controlled Mod. 1 is guided by the ship's wake	● 2,000 behind the ship's stern	10.9	●
Subroc ASW rocket (general purpose)	Ordinary or nuclear (explosion depth 300 m) and ordinary*	-	Supersonic	None	None	55	1,850
Harpoon ship-to-ship rocket** (against surface ships)	Ordinary or nuclear (20 kt)	-	Mach 0.8	Active radar homing head	●	110	687

*Two-thirds of the missiles have warheads with ordinary VV [explosive substances].

**Destruction radius for a PL [submarine] by the nuclear charge of the Harpoon rocket is 2,000 meters.

The basic tactical and technical data of the Subroc and Harpoon rockets, as well as the MK-48, MK-45 and MK-45F torpedoes, are cited in table 7.

The rapidity of torpedo firing has been increased thanks to the creation of devices for the rapid reloading of torpedo tubes, enabling them to be loaded in 4 minutes. This allows submarines to fire several salvos during a single attack and, during an attack on a formation or convoy, to strike a number of targets. High-speed computers enable several targets to be fired at simultaneously.

The use of devices for ejecting torpedoes from the tubes without the use of air, as well as the use of track-free electrical and steam torpedoes, has increased secrecy of firing.

The SINBADS torpedo-firing control system, developed in the Netherlands, makes it possible to observe surface and underwater environments, detect and track targets, select the type of torpedo, feed data into the torpedoes, and guide as many as three wire-controlled torpedoes to the target. The system depicts the situation on an indicator screen, tracks up to five targets from passive sonar installation data, and works out firing data simultaneously for three targets.

The torpedo tubes of some U.S. nuclear attack submarines are situated in the middle portion of the hull at an angle of 10-20 degrees to the diametral plane, while the bow part remains free for the placement of GAK antennas.

Modern foreign torpedoes can be fired from any depth of submarine submergence. Their effectiveness has become much higher than that of World War II torpedoes. A torpedo costs one-eighth to one-tenth as much as a missile.

Anchored and bottom influence mines, which are laid from the torpedo tubes, are intended for action against submarines and surface ships and craft. In the U.S. Navy these mines include the MK-57 influence antisubmarine mine, an anchored delayed-rising mine that lies on the bottom until the arming-delay and ship-counting devices are triggered, and also the self-transporting MK-27 mine (based upon the obsolete M-27 electric torpedo. After traveling a prescribed distance at low speed, the MK-27 lies on the bottom and is transformed into a bottom mine. Depth of laying is less than 200 meters for bottom mines, up to 300 meters for anchored mines.

Foreign specialists consider that the weaponry of SSN's corresponds to their mission and, along the nuclear power systems, helps to transform them into a general-purpose branch of the naval forces.

An enormous leap has occurred in the development of observational gear. U.S. SSN's equipped with the AN/BQQ-2 and AN/BQQ-5 sonar complexes can detect surface ships at distances of up to 220 km in passive listening modes and up to 56 km (under favorable hydrological conditions) in echo-ranging modes, determine their coordinates, and observe them for long time periods. The distance at which submarines are detected in the passive-listening mode is from 1 to 160 km, depending upon hydrological conditions and the submarines' noisiness.

The AN/BQR-21 passive sonar installation, with which search can be made by a narrow directional beam, enabling detection of submarines at distances of up to 160 km, is being introduced into the U.S.'s SSN's. All U.S. SSBN's should be equipped with them during current repair or overhaul.

Twenty-six U.S. SSBN's have been equipped with AN/BQR-15 sonar. These sets are also supposed to be mounted on nuclear attack submarines. The installations have a towed antenna. The cable-hawser is 800 meters long and 12 mm in diameter. The antenna is 82.5 mm in diameter. The winch's drive is hydraulic. The installation operates in the 2 Hz to 6.5 kHz band.

The system for measuring the distance to noise-emitting targets by the passive method (PVFFS, U.S.) enables firing according to computed data without the use of active sonar. It includes three receiving transducers, which are situated along the length of the submarine's hull. The target's location is computed electronically, according to the time difference in arrival of the sound at these transducers, and the data goes to the fire-control system.

Equipment for classifying detected targets enables them to be identified. The equipment for classifying a contact enables a detected submarine to be identified by means of spectral analysis.

The detection systems of operating U.S. sonars enable submarines to detect ASW forces and to evade detection themselves or to create interference with ASW operations (the distance at which active sonar operation is detected is greater than the operating range of the sonars).

Mine-detection equipment is installed on all SSN's.

Very great importance is attributed to reducing the submarine's own noise. This is explained by the fact that in the modern era only low-noise submarines can operate secretly and their sonar complexes alone provide the necessary range of detection of the enemy and observation of him (their own clutter is not greater), thereby enabling the submarines to use weaponry in good time or to evade the enemy.

Abroad they have begun to install not three-bladed but five-bladed and six-bladed screws on submarines (Britain is making seven-bladed screws), since a submarine with five-bladed screws has cavitation, which causes a sharp rise in noise,and it is not observed throughout almost the entire speed range. Noise intensity, in the foreign specialists' opinion, rises with increase in the number of screws, so single-shaft boats with a low screw rpm are being built abroad.

A submarine's hull also is a source of noise. In order to reduce noise from the flow of the water, the hulls are given a more streamlined shape, with a length-to-width ratio of 6-7, in the shape of a body of revolution with the detachable or retractable protruding parts placed inside the between-hulls space. Because noise increases at high speeds (about 30 knots), even where protruding seams are welded, and where poor painting and poor state of coatings and the slightest unevenness and roughness are reduced to the minimum, all orifices in the false hull are, insofar as possible, covered or placed outside of sections with great pressure differentials, and the sonar installation fairings are integrated with the false hull.

In order to reduce noise from rudder reverses, the rudders are placed ahead of or about the screw.

The most reliable method for reducing the submarine's internal noise is thought to be exclusion of the noisier mechanisms from the equipment make-up. The United States built the experimental nuclear submarines "Narwhal" and "Glenard P. Lipscomb" with reactors that circulate the coolant naturally without main circulation pumps for the primary circuit. This reduces their noisiness considerably. A small, low-noise reactor and outboard submersible electric motor were tested on the experimental NR-1 SSN. On a "Los Angeles"-type nuclear attack submarine, the main power plant was suspended on an internal ring that was connected with the pressure hull by shock absorbers, and the main turbogear assembly was submerged in oil. A submarine with direct-drive reducer-free turbine and coaxial propellers also has been built. Noisemaking mechanisms are installed on shock absorbers, and noise-absorbing branch pipes are installed in pipelines and steam lines of mechanisms equipped with shock absorbers. More than 800 flexible branch pipes designed for high pressure have been installed on each U.S. SSN. Vibration-damping coatings are used for seatings. The air noise of mechanisms is fought by applying sound-absorbent coatings and installing sound-absorbing screens.

In the United States, newly constructed submarines are inspected for noise prior to transfer to the fleet. The number of measurements made during a check comes to 2,000. During operation, measurements are made at least twice per month. Each boat is checked for noise prior to a cruise. If the noise level exceeds the permissible limit, going to sea is prohibited. Noise is measured also while under way by noise meters installed on the false hull (their indicators are at the sonar posts).

Foreign submarines have radars that are used while navigating at periscope depth or on the surface.

In Great Britain RDL-1BCS and RDL-4BCS electronic-reconnaissance equipments designed for searching for and finding directions on enemy operating radars and distinguished by high-speed operation have been created for submarines. The first set operates in the 3-15 cm waveband, the second in the 1.5-12 cm waveband. They also enable determination of the frequency of the signal from a radar whose direction has been found. Moreover, small British submarines have an RWR-1 set for warning of illumination by enemy radar.

In the United States a thermal direction-finder has been developed specially for installation on submarines.

Television equipment is used while cruising under water, for the purpose of observing the water's surface or the ice cover. The AN/BQX-1 television (U.S.) observes the icefield while the submarine cruises at a depth of 120 meters, at ice thicknesses of 15 meters, under lunar illumination.

Periscopes with telescopic optics and a television attachment enable several sectors of the horizon to be observed simultaneously.

Thus, the observation resources of modern submarines have been sharply increased over the observation equipment of World War II submarines, especially the sonar, whose operating range has increased 10-fold.

In order to increase secrecy and defense against acoustic homing torpedoes, submarines are equipped with sonar countermeasures. In order to create interference against active sonar, there are drifting self-propelled and ship-based interference equipments, and for screening there are simulators that create in the water a cloud of gas bubbles that imitate a submarine. Submarine simulators reproduce their noise and the reflected acoustic fields and create a ship's wake that reflects sonar transmissions. These imitators can maneuver in course and depth for about 2 hours at a speed of 8-10 knots.

Antisonar coatings are used on hulls to reduce detectability by sonar.

A device for the jamming of sonars that was developed in the United States, based on a small electric torpedo, imitates submarine noises in the 0.1-1 kHz band and maneuvers at depths of 15-120 meters. When signals are received from an ASW surface ship, it amplifies them and retransmits them back.

Modern foreign underwater acoustic communication and identification gear enables submarines to communicate with each other at distances of up to 20 km and to perform identification.

The U.S.'s hydroacoustic submarine communications equipment AN/BQA-2, which is included in the AN/BQQ-2 sonar complex, generates specially formed signals that make submarine detection difficult for the enemy, aiding the secrecy of the communicating submarines and the secrecy of the communications.

The 2010 attachment to the 2008 (British) hydroacoustic communications installation has been developed, during tests of which 98 percent of text transmitted was received at a high transmission rate without distortion. This was achieved by using a self-correcting code that enabled observation and correction of errors as well as automatic printing of the messages received. It is considered that the 2010 attachment will enable information exchange between submarines to be increased severalfold and the range of their communications with surface ships to be increased. It will provide for operation of the communications equipment in character-printing, telegraph and telephone modes.

Radio communications equipment enables submarines to have two-way radio communication with shore CP's and surface ships and between submarines. The equipment includes radio receivers and transmitters, as well as ultrashort wave transceivers that are used with retractable and towed antennas under the water and on the surface. Radio reception is accomplished on ultrashort-waves, short waves, medium waves, long waves and superlong waves, while radio transmissions are made on ultrashort waves, short waves and medium waves.

In order to increase the secrecy of communications, superhigh-speed devices that increase transmission speeds to 1,000 words per minute and copying units that receive radiograms transmitted at high speed are being created abroad. Frame and loop antennas and long-wave receivers enable submarines to hold radio reception at depths of up to 25 meters. In order to communicate with surface ships and aircraft, buoy antennas that float to the surface are used under water, while under way or while dead in the water. In order to communicate with aircraft, use is made of hydroacoustic radio-sonar buoys, which receive radio messages from aircraft and transmit them under water on a hydroacoustic circuit, and, vice versa, which receive the submarine's hydroacoustic messages and transmit them by radio to the aircraft. For radio transmissions to submarines that are submerged to depths of 12-30 meters, ground-based superlong-wave radios with an output power of up to 2 MW have been created. They operate on frequencies of 10-20 kHz. The U. S. Navy has such stations in Japan, the Hawaiian Islands, the Panama Canal region and other places. Moreover, the United States uses Earth satellites (ISZ's) as relay stations in systems for communicating with submarines, as well as reconnaissance ISZ's for detecting sea targets for and issuing target designations to submarines. The impossibility of radio communication with submarines while they cruise at great depths is a deficiency of radio communications.

Navigation complexes include: ship inertial navigation systems, which provide for storage of the ship's current coordinates and indication of the course and which make up the main complex; radio direction finders; reception displays for phase, impulse and phase-impulse difference measuring systems; astronavigation systems; radiosextants; gyrocompasses, gyroazimuths; logs; acoustic depth finders; under-ice upward-scanning fathometers; ice-lane indicators; iceberg detectors; and on-board systems for using Transit-type satellite navigation systems.

In order for a submarine to determine its position in the ocean without surfacing, the Pilotfish system of hydroacoustic responder buoys is installed. Navdac-type computers process the data that arrive from the complex's system and monitor the operation of its elements. The navigation complexes enable the ship to fix its position at sea with a precision of ± 1.6 km.

The surface speed of submarines of the imperialist states does not exceed 20 knots, but the underwater speed of SSN's reaches 30 knots. This is two to three times greater than the full surface speed of diesel submarines, which can proceed at these speeds for no more than 1.5-2 hours without charging their storage batteries. High underwater speeds enable SSN's: to secretly cover the areas assigned to them in a short time and to spend a greater portion of submerged endurance on patrol, to spend less time than diesels on passage, and, consequently, to accomplish the mission with a smaller number of submarines; to attack ships maneuvering at high speeds even under conditions unfavorable to the submarine at the start of the attack; to track detected high-speed targets for a long time; and to successfully evade observation, break off from an attack and evade weapons launched by antisubmarine forces. In stormy weather SSN's have a speed advantage over surface ships, since the latter are forced to reduce speed when waves are high.

The cruising distance of submerged SSN's has increased to 400,000 miles, which exceeds the cruising range of submerged diesels (without recharging their storage batteries) by 1,000-fold, and of surfaced diesels by 28-fold.

The underwater endurance of SSN's has reached 100 days, during which they can stay submerged. The reserves of fuel, lubricants and provisions do not limit their endurance. The main factor that determines endurance has been habitability, which, in the opinion of foreign specialists, is determined by:

the radiation dosage, which is maintained at a level safe for people (there are radio-chemical laboratories on U.S. SSN's for monitoring the radiation level);

a microclimate that provides normal life-support conditions with regenerating and air-conditioning systems;

the noise level in the premises;

a rational layout of battle stations and living premises;

improvement of equipment and the finish of compartments; and

rational organization of work, recreation, eating and medical services for the crew.

The operating submergence depth of U.S. SSN's has reached 270 meters (twice the depth of submergence of 21-series German submarines of military construction), and the maximum is 487 meters (France's SSN's). The great range of submergence depths enable SSN's to choose that depth at which their sonar will have the greatest operating range and at which the probability of detection and destruction of them by enemy weapons will be least.

Crews on SSBN's (which do not exceed 150) are larger than on diesel boats but are only a small fraction of those on surface ships that are equal to them in displacement (for example, the crew of the nuclear-powered cruiser "Bainbridge," with a displacement of 7,000 tons, numbers 451). However, in order to attain a high coefficient of operational burden for combat patrolling, all SSBN's have two crews, which go to sea alternately for patrol and combat training on the very same ship.

Modern submarines differ sharply from those of World War II in the availability of automated equipment. The use of automated equipment has caused, in foreign specialists' opinion, a great rise in speed of the processes associated with the use of modern weapons and equipment and an increase in the amount of information, given which, the timely adoption of correct decisions and their implementation often exceed man's potential. The large amount of automated equipment has enabled the number of people in the crew to be reduced.

Automated equipment is used in systems for missile and torpedo weapons, target designation and counteraction, detection, classification and observation, power-supply control, communications and identification, navigation, control of maneuvers, and support of habitability and crew training. The installation of systems for comprehensive automation, in which continuous-action computers (modeling computers), the unifying element of the system, are used, has started on foreign submarines. Comprehensive mechanization requires very high reliability of the material aspect of the submarine. Control of the vertical and horizontal rudders is combined--they are controlled by one person. The Conalog television screen depicts the movements of the ship in space.

High underwater speeds and cruising distances, great submergence depths and underwater endurance, good habitability, low noise level and detectability, great operating range and secrecy of the observing gear and of communications under water, high-yield rapid-firing long-range weaponry used secretively under water, hydroacoustic equipment for countermeasures against enemy observation and weaponry, navigational equipment that provides for high precision in underwater cruising, and the automation of many processes have transformed the modern submarine into a truly underwater ship and greatly increased its combat potential and combat stability over those of World War II submarines.

However, despite the improved equipment, the accident rate of the United States' SSN's remains high. For example, as a result of a dive to a depth beyond the limit, the "Thresher" sank in April 1963 (the whole crew of 129 was lost) and in May 1966 the "Scorpion" and its crew of 99 were lost.

The causes of accidents on U.S. submarines were failures of power-supply installations and their auxiliary equipment (33 percent of them caused high radioactivity in the compartments), fires and explosions, navigational errors, leaky pipelines, damage to the hull and retractable devices, and malfunctions of hydraulic systems.

Cases were noted of collisions of submarines with surface ships and craft, submarines getting into fishermen's nets and collisions with other submarines, which testify either to the poor condition of the sonar complexes or other observational gear or to poor crew training.

The United States has developed a buoy (and so have Great Britain, France, Canada and Sweden) with a cable 6,000 meters long and a telephone for communications that automatically surfaces from a sunken submarine. On the buoy is an inflatable balloon with a radar reflector for detection by aircraft and ship radars. The buoy rises with a strong jarring of the submarine, or when it is submerged to a depth beyond the limit.

Foreign submariners have individual and collective rescue equipment. Crew members are supplied with individual radio transmitters that enable their position on the sea surface to be determined. The U.S. has built two deepwater rescue equipments--the DSR-1 and DSR-2 (the weight of each when fully loaded is 63 tons, the depth of submergence is 1,500 meters, underwater speed is 5 knots, and each has a crew of 3; one equipment can receive 24 men simultaneously; it can be mated with a sunken submarine when its list is 45 degrees; and it is moved to the SSN on a transport airplane or a rescue ship). The FRG has developed a chamber that accommodates 24 people and rises from the submarine.

The United States is studying the possibility of creating a submarine that consists of several uninhabited compartments and one inhabited compartment, the latter capable of being separated from a sunken ship and of rising to the surface by means of its own engine installation.

The Construction, Modernization and Repair of Submarines During the Postwar Period

While doing research necessary to develop the submarine fleet, the United States has built and is building experimental submarines and small series of them. The submarine "Barracuda" was built in 1951 in connection with research to develop new observation gear. In order to study the possibility of using the Regulus cruise missile on submarines, two diesel submarines were refitted in 1952 and then the special diesel submarines "Grayback" and "Growler" were built. In 1953 research for selection of the most suitable configurations of hull and screws, conditions for operation of the sonar and systems for controlling the ship's maneuvering was started on the specially built high-speed "Albacore." Moreover, soon after the war 10 submarines were reequipped and two diesel submarines were built for radar picket work and the development of radar equipment.

Thus, a small number of diesel submarines was built in the United States during the postwar period for research connected with converting the submarine fleet to new power systems and weapons. There was no large-series construction of combat diesel submarines in the United States after World War II.

Nuclear attack submarines were built in the United States:

--in 1955, the "Nautilus," with a water-moderated water-cooled reactor; and

--in 1957, the "Seawolf," with a reactor that used liquid-metal as the heat-transfer agent.

Both were built basically for tests of nuclear reactors. The reactor on the "Seawolf" did not withstand the tests and was replaced by a water-moderated water-cooled reactor. The radar picket SSN "Triton" was built in 1959. In 1960 it was converted to the attack subclass of submarines, and later it was transferred to the reserve. In 1958-1959 the United States built the nuclear attack submarines "Skate," "Seadragon," "Sargo" and "Swordfish," and in 1960 the "Halibut" and "Tullibee." The "Halibut," which was armed with Regulus cruise missiles, was converted in 1965 to the attack subclass, since its Regulus rockets were recognized as unpromising. The "Tullibee," a low-noise submarine built as a hunter-killer, was equipped with new sonar and had a turboelectric drive for the propeller. In 1961 it was converted to the attack subclass of submarine. This concluded construction of nine experimental SSN's of the first generation.

New experimental ships were and are being built for research and the solution of new problems.

The United States built (in 1965) and is operating the low-noise SSN "Jack" with direct-action nonreduction-drive turbine and coaxial propellers; for research connected with creating deepwater submarines, a test diesel submarine, the "Dolphin," was built with an operating depth of submergence of 900 meters, and small experimental deepwater submarines were built: the nuclear-powered NR-1 and the diesel-powered "Lirs," which had a depth of submergence of 2,500 meters. In 1959 the submarines "George Washington" and "Skipjack"--prototypes of the main subclasses of nuclear-powered missile-armed submarines and nuclear-powered attack submarines--went into operation.

After building 41 SSBN's, the USA in 1967 temporarily stopped construction of them.

The U.S.'s long-range shipbuilding program calls for the construction of 30 "Ohio"-class SSBN's for the Trident system and their introduction into operation to replace 10 "George Washington" and "Ethan Allen"-class Polaris-Poseidon SSBN's. The construction of 5 Trident-system SSBN's and 12 nuclear attack submarines is planned for the five-year program of 1976-1980 (the keel of the first "Ohio" SSBN was laid in April 1976, and its introduction into the fleet is planned for 1979; the keel of the second SSBN, the "Michigan," was laid at the end of 1976). The 1972-1982 program plans the launching of 46 nuclear attack and 14 missile-carrying submarines (2 of them carrying cruise missiles). The construction costs of the Trident-series SSBN's is 1.2 billion dollars.

When the United States modernized its SSBN's, the Polaris missiles were replaced by Poseidon missiles on 31 "Lafayette" and "Madison"-class submarines.

During SSBN modernization, Polaris A-3 missiles were installed on 10 SSBN's (of the "George Washington" and "Ethan Allen" classes) that had previously been equipped with the Polaris A-2. A series of 31 "Los Angeles" class SSN units is being built--an improved variant of the "Sturgion," and the prototype was accepted by the navy in 1976. It is proposed to bring the number of nuclear-powered attack submarines up to 72 units by 1979 and to build 90 units altogether, excluding all diesels from the navy by 1980.

It is proposed to arm all SSBN's with antisubmarine Subroc rockets, to increase their combat stability, and to replace 4-year service-life reactors with 8-year service-life reactors.

SSN's are built in the United States by the sectional method. The construction period for Polaris-Poseidon system SSBN's averaged 25 months.

Britain and France are building SSBN's and nuclear attack submarines, the TTE's of which are similar to those of American in-service submarines. The keel of France's first nuclear attack submarine was laid in 1976, and its introduction is planned for 1980 (its main TTE's: a surface displacement of 2,385 tons, a submerged displacement of 2,670 tons, two turbogenerators of 2,400 kw each, a submerged speed of 25 knots, four 550-mm torpedo tubes, and a crew of 66). In 1978 France concluded construction of the last series of diesel submarines--four "Agosta"-class submarines.

In order to carry out special tasks and to provide for combat training, Great Britain has plans to revive the construction of diesel-powered submarines. It is planned that they will replace the old ones being withdrawn from the fleet. One of the reasons for this decision was their lower cost in comparison with nuclear submarines (10 and 25 million pounds sterling, respectively).

The FRG, Japan and Sweden are building small series of diesel attack submarines, mainly for ASW in coastal areas and for the combat training of ASW forces.

Italy and Japan are doing research on the creation of SSN's.

Canada, the FRG, Sweden and the Netherlands are examining the question of building SSN's.

Table 8 shows the makeup of the submarines of the main capitalist states.

The matter of building 5 SSBN's is being discussed in Great Britain.

France is planning to complete construction of a fifth SSBN in 1979-1980.

The United States plans to overhaul up to 10 SSBN's annually. Simultaneous with overhaul, the submarines are being partially or completely moddernized. In the United States, modernization of SSBN's is combined with overhaul, recharging of nuclear reactors and the installation of a new system for missile firing, sonar complexes, radio and electronic equipment and auxiliary mechanisms. Average time for modernizing each U.S. SSBN under the Polaris A-3 program was 18-19 months, under the Poseidon program it was 15 months. Time between SSN overhauls is 4.5-5 years in the United States, 3-4 years in Great Britain, and 2.5-3 years in France. The overhaul of British nuclear attack submarines takes 25-28 months, of British SSBN's 12-15 months.

Table 8

Number of Submarines in the U.S., British and French Navies on 31 July 1978

Country	Submarines in operation			Submarines being built	
	Nuclear		Diesel	Nuclear	
	Missile	Torpedo		Missile	Torpedo
United States...........	41	68	8	7	28
Great Britain...........	4	10	17	-	3
France..................	4	-	23	1	1
Total.............	49	78	48	8	32

U. S. SSN's are overhauled after combat patrol by the forces and resources of tenders at advanced bases by the unit method, under which components and modules that require repair are removed and replaced by spares available on the tenders.

An increase in the number of U.S. Navy submarines caused an expansion of their repair base in the 1970's. There are 9 shipyards, at which 85,000 people work, for overhauling submarines. Strict monitoring of the vibration level of submarine mechanisms has been established at shipbuilding and ship-repair yards in the United States, and this is accomplished by means of sonar monitoring stations at piers that are located in areas with low levels of natural and industrial hydroacoustic clutter. The mechanisms for the various operating regimes on the submarine being checked are switched on in sequence. Measurement lasts 10 hours. Air noise, machinery vibration, seatings, hull structure, the level of the acoustic near field in the area of the operating mechanisms, and the levels of the acoustic far field at distances of some hundreds of meters are measured. The measurements are compared with earlier readings and with the maximum permissible readings. A submarine with an underwater noise level of more than 72 dB may not go to sea. Frequently, after the measurements submarines have to be returned to the shipyard for steps to be taken to reduce the noisiness. Special attention is paid to balancing the propellers--to their geometry, the status of the blade edges and the fineness of their machining finish. When necessary, blade surfaces and hubs are buffed. When the acoustic-vibration characteristics do not meet the appropriate requirements, the mechanism is replaced by a new one.

Great importance is attached to the organizational aspect of overhaul. As the American press reports, special computer programs are prepared that issue recommendations about the direction of the work and define the degree of its execution (the Transsim program).

Vibration characteristics during the detection of defects in mechanisms avert the unsubstantiated stripping of mechanisms (about 80 percent of the mechanisms whose repair is called for actually do not need repair, which their vibration characteristics confirm).

The use of engineering diagnostics systems, in the opinion of foreign specialists, enables the time between overhauls of mechanisms and systems to be extended.

The Organization, Operations and Tactics of SSN's

The Organization, Operations and Tactics of SSBN's. U.S. SSBN's are organized into squadrons. Under organizational documents, each squadron consists of 9-11 submarines (actually, sometimes there are more, sometimes less), a tender, a floating dock, high-speed transport, and repair ships. The squadrons, under routine organization, are subordinate to the commanders-in-chief of the Atlantic and Pacific fleets. The Joint Board for Strategic Planning of the United States selects targets for them. The order to launch missiles can be issued only by the President of the United States.

SSBN's are based at bases on U.S. territory and at advanced bases, close to the regions of their patrolling-- Holy Loch (Great Britain), Rota (Spain) and Apra (on the island of Guam, in the Pacific Ocean). This provides the greatest operational utilization factor for them and reduces the probability of destruction of the U.S.'s own territory by enemy nuclear blows aimed at destroying the submarines at bases. Basing at advanced points is provided by mobile basing resources. It is envisaged that they will go to sea or to previously selected sheltered anchorages where, if a threat of war arises, they can load the SSBN's with missiles, replenish the reserves of torpedoes and all types of supplies, conduct current repair and provide for crew change. Each tender supports 10 SSBN's.

Upon completion of a combat patrol an SSBN goes to an advanced base for restoration of combat capability, which lasts for about 1 month. During this period the crew is changed, reserves are replenished, preventive inspection and repair of systems are performed, and a portion of the missiles is replaced. SSBN's are closely guarded at the basing point. Every 4 hours aqualung personnel inspect the underwater portion of the hull.

Rear-area bases for the U.S.'s SSBN's are at the navy bases of Charleston, New London and Pearl Harbor and the estuary of the Hooper River (in the U.S.). In addition to ship-repair yards, warehouses, arsenals and hospitals, training centers and crew-manning centers are located at the U.S.'s rear bases for SSBN's.

Great Britain's SSBN's are made up into a squadron, whose personnel are stationed at the naval base of Faslane in the Shetlands.

France's SSBN's form a squadron, are part of the naval strategic forces and are based at the Ile-Long (Atlantic Coast) base. The commander of France's strategic naval forces is directly subordinate to the president of the republic in matters of SSBN use. The crews of France's SSBN's are made up only of those who want to serve on them (a crew consists of 15 officers, 102 petty officers and 18 seamen). The crew's main training is performed in specialized training centers, where simulators are widely used. This saves SSBN resources and reduces the time for drilling a crew in combat training tasks. Crews are formed over a period of 2.5 years: this starts long before launch of the SSBN being built and ends prior to its entry into the combat-ready forces.

The U.S.'s SSBN's have been patrolling the oceans and seas that wash Europe's and Asia's shores since 1960, Britain's SSBN's since 1968 and France's SSBN's since the start of the 1970's. Each sortie lasts 60-70 days, and the interval between cruises is 90-110 days. The main task during patrolling is to be in the highest readiness to execute nuclear-missile strikes on previously designated targets on the probable enemy's territory, with the observance of maximum secrecy. The SSBN's maneuver in vast, highly secret regions of the oceans and seas, from which strikes on the previously designated targets can be inflicted. Knowledge of one's position with the precision necessary for the strike is provided by the inertial system of the navigational complex, and also by regular position determination by celestial fixes and shore-based and space radio-navigation system, and by hydroacoustic beacons. It is considered that SSBN's can begin to launch missiles within 15 minutes after receiving the order to execute a strike and complete it within 15 minutes after start of the launch, releasing all 16 missiles at intervals of 1 minute each.

SSBN's follow these tactical measure in order to observe maximum secrecy while patrolling areas and during sea passages:

--they cruise at submergence depths that will provide for the greatest operational radius of the sonar equipment that observes the enemy's ASW forces most dangerous to them, and for the shortest operating ranges of the enemy's means for observing them;

--they use low-noise speeds, which do not exceed an average of 5 knots;

--they evade ships, craft and aircraft that have been detected, developing full speed, when necessary, to break away from them;

--they use sonar countermeasures; and

--they use observation and communications gear only in a passive mode and retractable devices mainly at night.

When evading a surface ship, an SSBN turns on its on-board jamming device for suppressing the receiving circuit of the ship's active sonar, it aligns its jamming devices, and, maneuvering in depth, course and speed, makes it difficult for the ship to determine the submarine's coordinates, and, in wartime, it uses its weapons. At the start of combat operations, SSBN use of torpedoes and antisubmarine missiles prior to launch of the ballistic missiles is prohibited. After launch of all the ballistic missiles, return of the submarine to its base is envisioned.

The operational utilization factor of the U.S.'s SSBN's on patrol reaches 0.7; this is provided for by the high reliability of the operation of their materiel and by the existence of two crews for each SSBN. In 12 years the SSBN's have made 1,000 combat-patrol sorties. In the 4.5 years that the SSBN "George Washington" spent in operational components, it made 15 patrol sorties and, in so doing, traveled 100,000 miles under water in 1,020 days.

In the opinion of American specialists, inadequate range of the missiles, weak defense of combat patrol areas from the enemy's antisubmarine forces, remoteness of the patrol regions from the U.S. and the resulting necessity for expensive advanced bases, and difficulty in controlling SSBN's at sea at great distances from command posts are inherent in the Polaris-Poseidon system.

The Organization, Operations and Tactics of Nuclear-Powered Attack Submarines. Under routine organization, these American submarines are assigned to flotillas that consist of 3-5 squadrons each. A squadron consists of 5-10 boats. Under an operational-type of organization, flotillas are assigned to the operational fleets and to the antisubmarine forces of the Atlantic and Pacific theaters.

The leadership of the U.S. and British navies considers the struggle against the enemy's submarines, primarily SSBN's, to be the most important mission of nuclear-powered attack submarines.

It is considered that nuclear attack submarines, when executing antisubmarine warfare tasks, can operate in areas close to the enemy's submarine bases, on his sea passage routes (within the antisubmarine forces' boundaries), in areas where the enemy's SSBN's probably are patrolling, in regions of combat operations of friendly surface ships, and on the sea passage routes of friendly SSBN's for the purpose of destroying the enemy's antisubmarine submarines.

ASW submarines seek out the enemy at low speeds, when their own noise is least. They can operate separately or in groups, as well as in coordination with land-based patrol aviation and ASW groups. Sometimes they are assigned to an ASW group.

Foreign specialists consider that the struggle with enemy submarines can be more effective with the close coordination of diversified ASW forces and equipment, but the joint action of ASW submarines and aircraft can be successful only where there are reliable two-way communications between submarine and airplane (or helicopter), reliable high-speed means of identification on them, a precise knowledge of their own locations at sea, the existence of a potential for mutual orientation, and high development of their coordination. Violation of these requirements, they consider, can lead to accidental attacks on their own submarines by their own aircraft and helicopters. These requirements cannot at present be satisfied because of the short distance and poor reliability of communications with submerged submarines, as well as inadequate development of methods for joint operations with other forces.

However, the coordination of nuclear attack submarines with aviation and surface ships is being perfected. Exercises for ASW barriers, which consist of ASW groups, nuclear and diesel submarines, patrol aircraft, and surface ships are conducted systematically. During exercises the submarines maneuver in a strip of probable enemy submarine movement. The width of the maneuver areas is determined on the basis of the presumed width of the strip of probable movement of submarines and of the number of ASW submarines. During the search, each ASW nuclear attack submarine maneuvers so as to provide for the lowest level of its own noise and the best conditions for direct listening. During the exercises, nuclear attack submarines with AN/BQQ-2 sonar complexes have operated successfully, having detected "enemy" submarines within a band 60 miles wide (a submarine of the "Los Angeles" type, according to the Americans' computations, can reliably monitor a region of 60x60 miles). In order to prevent accidental attacks on each other, each nuclear attack submarine is prohibited from leaving its own position, since the reliability of means of identification is still inadequate. A submarine detected within the boundaries of another submarine's station is considered an "enemy." During the exercises, the passage of their own submarines through ASW positions was worked out. In so doing, the submarine that was completing the passage obtained authorization of the ASW forces to enter the ASW position that was located on the route, and the latter was warned about this. In the interests of safety, it was prohibited that weapons be used during the passage, and both submarines were assigned to different submergence depths.

It is considered that in time of war ASW nuclear attack submarines will use the positioning method most effectively at approaches to the land bases of the enemy's submarines, in the regions where they patrol, in areas of the launch positions and at ASW barriers. These submarines can be used in an ASW escort of units of large surface ships, primarily nuclear-powered aircraft carriers--this is one of the missions of the "Los Angeles"-class submarine (at the same time, doubts are expressed about the potential of this type of coordination between submarines and surface forces because of the inadequate development of means of communication and identification). It is thought that ASW submarines can investigate regions where maneuvering of their aircraft carriers is planned and can be used to lay mines on the enemy submarines' passage routes.

During combat training, U.S. nuclear attack submarines are included in the escort of carrier strike groups, and they search for "enemy" submarines at distances of 72-160 km from the carrier.

The Americans are training in the use of nuclear attack submarines in joint operations with ASW groups and land-based patrol aviation, in order to detect enemy submarines and to warn other forces about them, since it is the nuclear attack submarines that have observation gear with the greatest operating range for detecting submerged submarines. Submarines of this subclass, in cooperating with ASW groups, usually should run ahead of the escort ships by a great distance. On observing the enemy submarine, the submarine should either attack it without delay or keep it under observation. Under the second variant, the rest of the ASW group should engage in destroying the "enemy," and the nuclear submarine should operate according to special instructions. Nuclear attack submarines use direct-listening sonars to observe "enemy" submarines. It is expected that active sonars will be used just prior to the salvo in order to refine the position of the target being attacked.

American specialists consider that, although much time is required, search by one submarine or by several of them is not without effectiveness. Optimal search speed of nuclear attack submarines, in their opinion, varies between 5 to 15 knots, and this is optimum because, as speed is increased, the operating range of the passive sonar is reduced because of the increase in their own noise. They assert that tracking several tens of SSBN's of a probable enemy during peacetime is a difficult task and the possibility of solving it is doubtful.

According to foreign press information, the U.S.'s nuclear attack submarines spend 70 percent of their time at sea working out antisubmarine warfare tasks and each year they participate in exercises, during which methods for operating against submarines are perfected. Foreign specialists consider that these submarines can operate successfully against enemy surface craft and ships by active search for them at sea and in the oceans, with attacks by solitary submarines, or by large units and convoys from various directions in group operations ("wolf-pack" tactics), but, in attacks by several submarines against one target, simultaneous direct listening of the target by two submarines is proposed, in order to increase accuracy in determining the distance to it and to maintain secrecy.

The U.S. press notes that "wolf-pack" operations by nuclear attack submarines will be made difficult by the inadequate development of means of communication between them and other forces and because of the enemy's possession of equipment for detecting transmissions and for jamming communications.

Beginning in 1957, U.S. nuclear attack submarines have regularly cruised under the ice of the Arctic basin and have been able to submerge and rise in water openings and clearings, laying out Arctic under-ice routes. Thus the submarine "Seadragon" laid out an under-ice route along the Portsmouth-Davis Strait-Baffin Bay-Lancaster Strait-Barrow-McClure-Central Arctic-Bering Strait-Pearl Harbor route.

In 1962 the "Seadragon" and the "Skate" completed a cruise to the North Pole, after rendezvousing 100 miles north of Severnaya Zemlya Island,

and then passing clear of each other in the Beaufort Sea. At the North Pole they surfaced. During the cruise they worked out antisubmarine problems, carrying out several attacks against each other, including torpedo launches. In company sailing they tried out gear for underwater audio communications. In the Beaufort Sea they participated in an exercise with ASW aviation. Shore-to-submarine communications with the submarines that had been operating in the Arctic were executed by a superlong-wave radio transmitter of 2,000 kw situated at Cape Cutler (U.S.).

The Americans have drawn the following conclusions from the results of Arctic submarine cruises: nuclear submarines can sail under the Arctic ice; under-ice radio reception is possible; there are ice openings and clearings in the Arctic Ocean basin where submarines can surface in both winter and summer; and SSN's are the best ships for dealing with ASW in the Arctic.

On 23 October 1976 the British SSN "Sovereign" surfaced in an ice opening at the North Pole during a 10-day cruise in the Arctic.

Many problems of the tactics of the SSN's of foreign states are still only being discussed. Many of their possibilities are not being used in practice. The "father" of the U.S.'s SSN's, Vice-Admiral Rickover, pointed to a dislike of their commanders to depart from the traditional "lone-wolf" ambush tactics and to an inadequate level of development of SSN tactics. He emphasized that nuclear attack submarines are being used hardly at all to escort surface forces and noted their poor training for group attacks.

The Role of Submarines in the Future and Their Influence on the Development of Navies and the Tactics of Other Branches of Naval Forces

The main role in the aggressive plans of American militarists is being played by the so-called triad of strategic offensive forces: intercontinental ballistic missiles, nuclear submarines armed with medium-range ballistic missiles, and strategic bombers.

The strategic defense forces combine the aerospace, antisubmarine and civil defense systems.

Admiral of the Fleet of the Soviet Union S. G. Gorshkov wrote: "Radical changes in the armament of navies and the new order on the World Ocean have causes changes in the views of the British and the Americans on the role of navies in a future war and on the order of priority and importance in their execution of missions. Problems of destroying surface targets and submarines have been moved up to first priority, while the traditional task of defense of their ocean lanes has become secondary since about 1957."*

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*Gorshkov, S. G. "Morskaya moshch' gosudarstva" [The Sea Power of the State]. Moscow, Voyenizdat, 1976, p 288.

Since 1966 the SSBN's of the U.S. have been officially considered the main strike force of its navy and the most important component of the American strategic offensive forces. Prior to this, strike aviation was considered the main strike force of the U.S. Navy (it has been converted to the category of general-purpose forces).

American specialists consider that SSBN's are capable of maneuvering launch positions over an area 20-fold greater than the area of maneuver of ground missile forces, the sea-based underwater nuclear-missile system is more survivable than the ground-base missile and aviation systems, and it can function both prior to and after mutual nuclear strikes. These were the qualities that helped its vigorous development and improvement in the 1960's and 1970's.

Six hundred and fifty-six Polaris and Poseidon ballistic missiles (more than 40 percent of the strategic missiles that the U.S. had at the time) had been placed on SSBN's built in the U.S. prior to 1967. In 1975 the SSBN's share of U.S. strategic missiles was 30 percent. After completion of the Poseidon program, out of 9,000 nuclear warheads, more than half of them will be on SSBN's. The number of nuclear munitions in one salvo of the U.S.'s SSBN's exceeds 2.5-fold the number of nuclear munitions in one salvo of the U.S.'s Minuteman strategic intercontinental missile.

Thus, SSBN's have held a paramount position not only in the Navy but also in the strategic offensive forces of the U.S.

The American press has said that the SSN is now the ideal embodiment of the classic principles of the military art--surprise, mobility, concentration of force and economy of force.

Because of this, one of the main tasks of U.S. SSBN's is that of applying nuclear strikes on large cities and administrative centers of the enemy, and their crews call themselves "city killers." According to the claim of American specialists, one Polaris A-3 missile is enough to destroy any city or target, and the destructive power of all the missiles on one SSBN exceeds all the power of all the explosives ever used in the history of mankind.

As a result of the appearance of SSBN's in navies, there are now no land areas beyond the reach of the most powerful nuclear missile strikes from the sea. And, while foreign specialists previously considered that the purpose of the drive against submarines was to insure the safety of sea haulage and the sailing of surface ships, the main thing now is the inadmissibility of their blows against vitally important targets of states. In the opinion of U.S. specialists, the search for reliable methods for destroying submarines is for the U.S. Navy a number-one task, and ASW defense is viewed as one of the most important areas of its activity.

The leadership of the U.S. and NATO navies considers nuclear attack submarines one of the more effective forms of ASW. Boats of this class are able to operate for a long time and in secrecy where the enemy's submarines operate; they have the best conditions for sonar operation and do not rely upon either weather conditions or the ice situation when performing ASW missions; and they can detect the enemy and determine the elements of his movements just by passive observation means, choosing for this purpose the best depth of submergence, without violating their own secrecy. This is the advantage of the SSN over ASW surface ships, aircraft and helicopters.

In comparing nuclear attack submarines with destroyers, foreign specialists note the following:

--although destroyers have the advantage of maximum speed over these submarines, they are inferior to them severalfold in endurance and in distance of running at this speed;

--destroyer speeds are reduced during high seas, while the speed of nuclear attack submarines does not depend upon weather conditions;

--destroyers are compelled to break off the execution of basic tasks several times per day to refuel, while nuclear submarines can take on nuclear fuel once in several years; and

--destroyers, in order to detect submarines, must use active dipping sonars (they are less powerful than ordinary sonars and have a number of operational deficiencies), while nuclear attack submarines make observations at any depth of submergence accessible to them.

Among the negative characteristics of nuclear attack submarines is the lesser potential, in comparison with surface ships, for operating in tactical ASW groups and the greater costs of construction in comparison with ships with ordinary power system.

Thus, while the SSBN's of the U.S. have become the main strike force of its navy and the main component of the strategic nuclear forces, which execute the main offensive task in a nuclear war, the nuclear attack submarines of the U.S. are a main component part of its ASW forces, which execute the main defensive task.

Foreign specialists consider that diesel submarines have a very small chance now of remaining undetectible by modern ASW ships, airplanes and helicopters.

The appearance of SSBN's in the navies of the United States, Great Britain and France has led to a reduction in the number of attack aircraft carriers in the navies of these countries, to a cessation of their construction in Great Britain and France, and to a conversion of attack aircraft carriers into multiple-mission aircraft carriers in the U.S., since SSBN's can be much more effective in destroying enemy surface targets in a nuclear war than aircraft carriers.

A limited number of nuclear aircraft carriers is being built in the U.S. They remain the main strike force in operations against ground targets in local wars (the war in Indochina) and, in the opinion of the American command, they are a highly trained reserve for the strategic forces in an all-out nuclear war.

The rapid growth in the number of nuclear attack submarines, which are capable of executing ASW tasks better than ASW aircraft carriers and other surface ships, has led to the exclusion from the U.S. Navy of old ASW aircraft carriers and to a reduction in the number of ASW surface ships. At the same time, U.S. specialists consider that even aircraft-carrier ASW aviation will be required in the war against submarines. According to their claim, shore-based aviation cannot operate in the ocean's central regions, so carrier-based aircraft are needed.

The following facts testify to the increased share of submarines, primarily nuclear. In 1977 the total displacement of the submarines of the United States, Great Britain and France--in operation and under construction--was about 740,000 tons, nuclear submarines comprising 700,000 tons. In these countries the total displacement of surface ships with nuclear power plants in operation and under construction was about 400,000 tons, and of all combat surface ships in operation and under construction--3.85 million tons, that is, the total displacement of SSN's exceeded the total displacement of nuclear surface ships 1.75-fold, and the total displacement of all submarines was about 19 percent of the total displacement of all combat surface ships. The share of submarines had risen 5-fold over the share of submarines at the start of World War II. The displacement of SSN's was about 96 percent of the total displacement of nuclear and diesel submarines.

The appearance of SSN's has led to a reevaluation of the existing forces in the fleets of the main capitalist countries, which is reflected to some degree in table 9.

Table 9

Submarines, Aircraft Carriers and Antisubmarine Warfare Surface Ships (Destroyers, Patrol Vessels and Frigates) on Hand in the Navies of the U.S., Britain and France in 1950-1978 (Not Counting Ships in Reserve)

Year	Submarines: Nuclear: Missile	Submarines: Nuclear: Attack	Submarines: Diesel	CV's	ASW CV's	Total SSN's	Total CV's	ASW surface ships
1950.........	-	-	262	43	83	-	126	1151
1955.........	-	1		28	12	1	40	
1960.........	2	11	62	22	16	13	38	981
1965.........	29	22	204	18	13	51	31	
1970.........	46	52	149	18	8	98	26	771
1976.........	49	74	54	16	-	123	16	275
1978.........	49	78	48	16*	-	127	16*	249

*Three of these are nuclear powered. Some are multiple-mission.

U.S. efforts to create ASW forces and equipment increase from year to year, reflecting, according to foreign press reports, the extreme importance and complexity of ASW. By the start of 1975 about 200 surface ships and more than 100 submarines had been equipped with ASW equipment.

ASW has become an independent strategic-operations task and, as foreign specialists consider, there are two fields: the battle against SSBN's, and the battle against SSN's that threaten surface ships and transports. The search for reliable methods for detecting, identifying and destroying enemy submarines has become a most important task of the U.S. Navy.

Because of this, the United States is doing the following work:

--ASW organization is being improved;

--oceanic and sea theaters are being equipped for ASW;

--improved equipment for search, detection and identification of submarines (including nonacoustic equipment) is being researched;

--new ASW weapons are being developed;

--new ASW ships and aircraft are being created and existing ones are being modernized; and

--new methods for using ASW forces and equipment are being studied.

According to foreign press data, U.S. Navy expenditures for the development of ASW forces and equipment from 1971 through 1975 rose from $2.5 billion to $4.5 billion. As much as 20 percent of the appropriations allocated to the navy were spent on the upkeep and development of ASW forces and equipment. The total sum of expenditures for developing ASW forces and equipment from 1974 through 1979 probably will be $20 billion. The major portion of these sums goes to the development of means for detecting submarines. The final goal is the creation of a global system of underwater observation for the World Ocean. From 1969 to 1978, $131 billion were spent on detection resources, as much as on the creation of the Poseidon nuclear missile system.

The ASW forces of the U.S. and NATO are being developed to have the capability to disrupt or greatly weaken enemy SSBN strikes on targets on their own territory. This mission of nationwide importance is considered paramount for the navies. U.S. specialists consider it necessary to create powerful ASW forces in peacetime, because the battle with submarines will be waged only with the forces available in the fleets at the start of the war.

As the underwater fleet improves, the role of surface ships in the overall ASW system has changed. Remaining as the main branch of forces for defending a target (an aircraft carrier force, a convoy, or a landing party), in all other operations they cede their former positions to submarines and aviation.

The ASW aviation (airplanes and helicopters) of the main capitalist states has begun to be developed rapidly with the appearance of SSN's in their navies. Aviation equipment that will measure the radioactivity of the water after the passage of an SSN is being developed in the USA. Research is being conducted on the creation of gear for searching for submarines by means of lasers (it is expected that this will make it possible to detect submarines at a depth of 120 meters from an altitude of 150 meters). It is possible that the U.S. will use space facilities (orbiting satellites) for detecting submarines and the missiles they launch. The U.S. plans to have infrared gear in the payloads of reconnaissance satellites that will enable the detection of submerged submarines. In order to destroy submarines, ASW aviation will be armed with airborne ASW torpedoes, torpedo missiles, depth charges and mines with both conventional and nuclear charges.

The NATO countries are establishing ASW barriers in the oceanic theaters of combat operations and in the straits zones of the seas. They consist, as a rule of automatic sonar stations and stationary sonar buoys, minefields, surface ships, aviation and nuclear attack submarines.

In the war against SSBN's the U.S. is creating coastal ASW zones 600 miles deep that consist of passive and active sonar systems and ASW forces.

Foreign specialists consider that ASW forces should be developed on the basis of the creation in peacetime of a system of ASW observation and tracking of each SSBN detected. Earth satellites will watch submarines at bases. At sea, when they are on the surface or at a shallow depth, submarines can be detected by earth satellites, ships, craft and airplanes (at combat-training firing ranges and in areas of routine activity). At greater depths of submergence, they are observed by ASW submarines and by the gear of the U.S.'s SOSUS hydroacoustic observation system, which is the main global system for observing the underwater environment and which includes individual stationary hydroacoustic systems for superlong-range detection of submarines. Zones and barriers for detection have been set up in the English Channel, the Strait of Gibraltar, the Japan Sea, the Caribbean Sea and Gulf of Mexico, on the U.S. east and west coasts, along the Aleutian Archipelago and the Kuriles-Kamchatka depression, on the coasts of Great Britain, the Philippines, Okinawa, Taiwan, Portugal, Denmark, Turkey and Italy, and in the areas of the Hawaiian Islands and the northern Azores.

The deepwater stationary systems Atlantic, Trident, Caesar, Coloss, Afar and Artemis for the long-range detection of submarines are a part of the ASW defense of the American continent. The active Artemis system in the area of the Bermuda Islands will include a number of superpowerful superlow-frequency transducers (to emit at up to 1 MW) that are located in underground shafts along the U.S. coast. They will make it possible,

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according to press claims, to detect submarines at distances of up to 500 miles. The receiving devices in this region are several hundred towers with hydrophones and Caesar hydrophones.

Deepwater habitable stations to detect submarines are being created that will be established at depths of up to 2,000 meters. This will permit the antennas of the stations to be extended more than 200 miles from shore. Crews will stay at such stations for 30 days.

In the U.S. the MSS system, which will consist of anchored sonar buoys with devices for accumulating undersea-target data that will be transmitted by radio by superhigh-speed equipment, on demand or independently, is being developed. It is expected that it will be possible to use the MSS system in areas with sea depths of up to 5,500 meters. Minimum operating life of a buoy will be 90 days.

The SAS stationary passive sonar system is designed for the superlong-range detection of submarines at depths of more than 500 meters in the North Atlantic and for tracking them. It will consist of hydrophones placed on supports that are installed on anchors beyond the edges of the continental shelf and will enable observation of submarines that are below the thermocline.

It is considered that in areas that are covered by long-range hydroacoustic observation systems of the capitalist states, the positions of submarines detected will be fixed with a precision of $\pm$ 16 km. This will enable ASW aircraft, submarines and surface ships to be used effectively in searching for and destroying a submarine after its position has been found by a long-range detection system.

Radio direction finders are being used to detect submarines at great distances. They operate even on brief radio transmissions from submarines. In order to discover submarine activity in the ocean, a grid of shore-based radio direction-finders on the Atlantic and the radio direction-finders of surface ships, airplanes and helicopters are used.

As reported in the foreign press, mines are one of the effective means for ASW. ASW mines can be placed as deep as 1,800 meters, with a mine-immersion depth of 540 meters, and can have mechanical, magnetic-induction, high-frequency (up to 30 kHz), low frequency (5-30 Hz), and hydrodynamic firing mechanisms (which detonate at a depth of up to 30 meters). ASW bottom mines can be placed at depths of up to 200 meters, but not less than 9 meters. New explosives for mine charges exceed the yield of TNT 1.7-fold, but they can be equipped with nuclear charges. It is considered that the laying of ASW mines on U.S. coasts and a warning about them can preclude sailing there by enemy SSBN's. On the ASW barriers it is proposed to lay bottom and anchored proximity mines. The opinion has been expressed that, in addition to surface ships, airplanes and attack submarines, SSBN's that have been reequipped as underwater minelayers can be involved in laying mines (with the placement of 256 mines on each of them--16 mines for each tube).

Attaching great importance to high quality in the control of submarines and considering that in wartime shore communications terminals can be attacked, the American command is creating reserve systems for control on long and superlong radio waves. The carriers of long-wave and superlong-wave transmitters should be ships and airplanes that are outside the areas of combat operations.

The appearance of SSN's in fleets and the increase in their numbers have exerted and continue to exert great influence on the missions and tactics of other branches of the main capitalist state's navies.

The range of missions that have confronted surface ships in the past has narrowed. The main task of attack aircraft carriers in the past--the destruction of important targets on the enemy's territory with carrier-based aviation--has been transferred in the case of an all-out nuclear war mainly to SSBN's. It is now planned that attack carriers will destroy targets on the enemy's territory, using aviation with ordinary weapons in local wars, and they will be a reserve for the strategic forces in case of nuclear war. (The volume of tasks of the Air Force's strategic aviation, a portion of whose tasks also has been vested in SSBN's, has been reduced.) The range of tasks executed by ASW surface ships also is being constricted, since a large portion of the tasks is being transferred to nuclear attack submarines. The tasks that face ASW aircraft carriers have been vested partially in multiple-mission aircraft carriers.

However, the operations of U.S. and NATO SSBN's in peacetime have confronted ASW surface ships with new missions: they should, jointly with nuclear attack submarines, prevent the detection of their patrolling SSBN's and the discovery of their patrol areas by the probable enemy's ASW surface ships. ASW tactics also have changed. It is considered that their main efforts now should be directed at the destruction of submarines on sea passage routes and in combat operations areas. For this purpose, it is planned to use a mixed ASW force.

Foreign naval specialists expect that in wartime, observation of SSBN's should be performed not only by stationary means but also by forces capable of destroying them before they use their missiles. There are two methods of tracking SSBN's--concealed and open. The main forces considered to be capable of concealed tracking are nuclear attack submarines and land-based patrol aircraft. Low-frequency direct-listening systems of nuclear attack submarines and passive radio-hydroacoustic buoys can be used for concealed tracking, and the active sonars of these submarines and radio-hydroacoustic buyos of the Julie type can be used for open tracking. Foreign specialists express the opinion that the use of active hydroacoustic gear will provide constant knowledge of the positions of targets and will enable them to be classified more accurately. The fact that an attempt is being made to solve many ASW tasks in coordination with nuclear attack submarines is new in the tactics of the surface ships and aviation of the United States and NATO. In this case, the task of establishing contact with an undersea enemy by data from submarines and of destroying him is vested in aviation and surface ships. It is thought that such a form of mutual operations can be used during ASW escort of naval forces, primarily aircraft carriers, landing detachments and large convoys and at ASW barriers.

Special attack groups that consist of surface ships with nuclear power plants and nuclear attack submarines are being created. According to foreign press reports, a group of such ships is capable of monitoring a water area about 450 miles in radius.

Foreign specialists consider that position-fixing sonar gear is the main ASW system for dealing with SSBN's in regions where they patrol and at ASW barriers. ASW forces that are maneuvered are guided to submarines that have been detected by stationary gear in accordance with the data from these facilities.

The most effective of the forces capable of tracking detected submarines turns out to be "Sturgeon"-class submarines, which have observed them by means of direct listening sonar systems at distances of up to 160 km. Active sonar is used mainly to obtain precise target-position data.

Attempts to organize the coordination of diverse forces have necessitated the solution of a number of serious problems of a technical and tactical nature, primarily those of communication with surface ships and aviation with submerged submarines and the identification thereof. Therefore, during joint operations of ASW airplanes and submarines in ASW barrier forces, strips for patrolling by ASW aviation are assigned in such a way that, even with the crudest navigational errors by airplane crews, the possibility of aircraft flights over the positions of their own submarines will be excluded. In their turn, the submarines are deployed relative to the areas of aircraft flight in such a way that enemy submarines whose routes they are tracking will encounter first the submarine positions and then the area of aircraft action. This is done to allow the ASW submarines to guide the aircraft to an enemy submarine that has been detected.

Foreign specialists assert that the phenomenon of SSN's with long-range torpedoes and missiles of the ship-to-ship class, and also the probability that the enemy's SSN's and aviation will use nuclear weapons, forces the distance between transports and escort ships in a convoy to be increased. As a result, the zone of ASW protection around the convoy is expanded to 100 miles or more.

It is considered that the defense of a target in the ocean, be it a force of surface ships, a convoy or an individual ship, consists purely of defensive actions, in which case the airplanes are used for long-range detection of submarines, and escort surface ships and their helicopters create a close-by zone of ASW defense. All of them should provide protection for the escorted targets and escort ships from cruise missiles, attacking cruise missiles with air-to-air missiles and ship-to-air missiles. Nuclear attack submarines execute long-range sonar observation and protect the surface ships from enemy submarine attack. Each carrier is protected by nuclear attack submarines, surface ships and airplanes. Their activity is supported by stationary sonar observation gear. Screening during sea passage and in the area of combat maneuvering is cyclic. When surface ships do not suffice, their functions are fulfilled by helicopters from aircraft carriers. In the cruising formation, the escort is reinforced in the bow sectors. It is assumed that, where there are escort ships with helicopters in the screen, submarines can be detected at distances of 18-30 miles from the center of the cruise formation.

Since operation of the sonar locators is detected by the submarine prior to being itself detected by them, it is recommended that only close-screen active sonars be used, and that the rest of the force should make use mainly of direct-listening and data from the helicopters to avoid serving as a homing beacon for the enemy submarine.

The main task of the close screen, according to foreign press data, is considered to be that of disrupting the attack and not that of destroying the submarine. Submarines should be destroyed on the passage route of the aircraft carrier or convoy by mixed aviation-and-ship hunter-killer groups, which consist of carrier-based and shore-based airplanes, ship-based helicopters, nuclear attack submarines and escort ships.

In general, the ASW escort of a large convoy, according to the claims of foreign specialists, appears to be like this:

--in the close screen, escort ships with the mission of warding off submarine and air attacks are placed a little farther from the transports than the range of a torpedo salvo from a submarine, creating a continuous zone of sonar observation;

--farther out to sea, 30 miles from the ships being escorted, carrier-based ASW helicopters and destroyers and frigates conduct sonar observation;

--in the outer screen, the multiple-mission carrier group should sail in the threatened direction at a distance of 40-50 miles from the convoy's ships; and

--carrier-based ASW aircraft and SSN's patrol 100-200 miles in the most threatened directions.

NATO specialists consider that in the future a convoy will include from one to six ships, depending upon their load capacity, since the sinking of one modern tanker or containership alone is equivalent to the destruction of several tens of ships of the World War II period.

The American press has expressed the opinion that ASW forces that can destroy half the enemy's SSBN's in the ocean in 10 days after the start of war cannot be considered a serious threat to the enemy and that the real threat to him would be ASW forces capable of executing this task in 10 minutes after the start of war.

The necessity for assuring secrecy of operations and the best conditions for one's own submarines and ASW forces to detect the seaborne enemy and to destroy him has compelled the Americans to engage seriously in a study of the oceans. With a view to making the most advantageous use of hydrological conditions in areas of submarine and ASW operations, the United States developed in 1966 and has adopted the ASWEPS system for collecting data and forecasting the oceanographic situation in oceanic theaters of combat operations. The instruments that support this system are installed on submarines, surface ships, buoys and the ocean bottom.

In order to improve the sonar equipment of submarines, the U.S. is intensively studying conditions for propagating sound in the oceans and is studying the sources and nature of its sounds in order to be able to distinguish ocean noise of any origin from the noise of enemy ships.

The United States expended $800 million per year on study of the World Ocean during 1975-1978.

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As is apparent from foreign press reports, the construction and preparation of submarines by the main capitalist states are being executed to take the experience of two world wars into account and to use all the latest achievements of science and technology. When submarines were equipped with nuclear power, they became truly underwater ships that possess great mobility and capability for operating secretly. This has increased their combat potential and combat stability severalfold. Arming them with the most powerful modern weapons--ballistic missiles, torpedoes and ASW missiles with nuclear charges--has made them the main forces of the navies of the main capitalist powers and the most versatile branch of the navy's forces, capable of executing many missions in armed struggle at sea and on land.

The development of SSN's in the postwar period enabled the U.S. to dispense with the construction of diesel-powered submarines back in 1959, and previously built diesel submarines were removed from the U.S. naval forces. Great Britain and France have greatly reduced the number of diesel submarines in their navies for the same reason, and they have reduced their construction in the 1960's and 1970's.

SSBN's have enabled the United States to free its naval carrier strike forces (including nuclear forces) from the role of the main strike force, and the development of nuclear attack submarines has enabled the elimination of ASW aircraft carriers from the navy, having transferred that task mainly to SSN's. SSBN's have been vested with part of the tasks that face shore-based missile units and strategic aviation of the United States.

The equipment for observation, communications and ship navigation, the greater depths of submergence, and the automation and computers of modern submarines enable them to collaborate closely with each other tactically, something that still has not been achieved with surface ships and aviation because of difficulties of observation, communication and identification between them. With the appearance of SSBN's in the fleets of the main capitalist states, about 70 percent of the SSBN's are constantly on combat patrol in a high state of readiness to inflict nuclear strikes.

Trends in the Development of Submarines of the Main Capitalist States

Five-year programs for building up the armed forces (including submarines) that the United States creates are revised annually. The NATO armed forces conduct research games regularly; the results are used to define trends in development of the naval forces.

The development of submarines continues. In order to increase their speed and reduce noise, all protruding parts of their hulls are being reduced. It is possible that the sail, which gradually is being lowered, will disappear. The buoyancy reserve is being reduced (instead of the 30 percent of the SSN "Triton," it has gone to 13-15 percent for the "Sturgeon,") the problem of creating low-noise equipment is being solved, and a nuclear reactor with natural coolant circulation, in which there are no circulation pumps, one of the main sources of noise, has been created. Experimental work on the creation of submarines with speeds of more than 40 knots continues. The U.S. has conducted tests on the submarines "Albacore" and "Pollack" ("Permit"-class nuclear attack submarines) of the use of polymer additives in the boundary layer of the hull that have given encouraging results for reducing hydrodynamic resistance and raising submarine speeds and secretiveness. Studies are being made on the creation of low-displacement SSN's. It is proposed that the crew of a comprehensively automated missile submarine will be 25-30 men, and 10-12 men for an attack submarine.

Foreign specialists expect that an increase in depth of submergence is one of the main problems of underwater ship construction, the solution of which will sharply increase the combat potential and combat stability of submarines. In their opinion, in the 1980's, the United States will have combat submarines with diving depths of 1,200 meters. It is also considered that the hulls of deepwater submarines can be manufactured from glass ceramics and fiberglass material.

Trends in Development of SSBN's and of Submarines with Cruise Missiles

The American press is claiming that the future role of underwater strategic offensive weapon systems will be raised, thanks to their secrecy and invulnerability. This is confirmed by U.S. practical activity in creating and developing submarine forces. Further promise for developing the navy depends directly upon the pace of adoption of the new strategic offensive nuclear-missile weapon system, the sea-based Trident, as armament.

Expenditures for the Trident system that is being created grow from year to year, and they appear to be as follows: $5.4 million in 1969,

$10 million in 1970, $44 million in 1971, $120 million in 1972, $942 million in 1973, $1.7 billion in 1974, $2.1 billion in 1975, more than $2.6 billion in 1976 and $3.2 billion in 1978. The cost of 10 Trident-system SSBN's, together with the missiles and expenditures on scientific-research and experimental design work, is $18.5 billion (the cost of 41 Polaris-system SSBN's was $10 billion).

In the opinion of foreign specialists, the Trident system will be to a great extent free of the deficiencies that were inherent in the Polaris-Poseidon system, and it will possess the best prospects from the standpoint of survivability in an all-out nuclear-missile war. Its creation has been executed at a speedy pace and should be completed prior to 1985. An increase in the firing range of the missiles to 11,000 km will enable an ocean area of 143 million km^2 to be designated as the patrol area for Trident-system submarines, that is, the zone from which they will be able to inflict strikes. In other words, the zone of combat patrolling will be expanded 14-fold over that of the Poseidon missile system (they maneuver in patrol regions 9 million km^2 in area). Areas close to U.S. shores can be designated as Trident-system submarine patrol areas. This, the specialists assert, will raise the system's survivability because of the difficulty enemy ASW forces will have in operating over such vast protected regions that are far from his bases. A sharp increase in the area of missile-carrying submarine patrol regions will require of the enemy a great increase in the ASW forces' job of dealing with them, in the range of observational gear, in search speeds and in number of weapons of these forces. It is considered that, when the Trident system is adopted as armament, the United States can dispense with the need for bases for submarine missile carriers in foreign lands and the control of submarines will be simplified.

The Trident system is being developed in the two following directions:

--the creation of the Trident-I missile with a firing range of about 8,000 km, based on the Poseidon rocket; it will be possible to arm both Polaris-Poseidon submarine systems and submarines built especially for the Trident system with it; and

--creation by 1979 of the Trident submarine system, and, by 1981-1982--of a new three-stage Trident-II ICBM with a firing range of about 11,000 km.

The TTE's of Trident-system SSBN's are: displacement 18,700 tons, length 170 meters, draft 11 meters, 24 launch tubes, four 533-mm torpedo tubes, a submerged speed of 20-25 knots (with combat patrolling at 5 knots), a diving depth of 1,000 meters, a low noise level (overall noise-level one-half to one-third that of the quietest modern SSN), a nuclear reactor with natural coolant circulation and water cooling, a reactor-core service life of 20 years (the boat can travel 1 million miles without recharging the reactor), electric propulsion, a shaft rating of 30,000 hp, a submarine service life of 30 years, an underwater operating endurance of 70 days, time between overhaul of 9 years, traditional architecture, and a crew of 14 officers and 136 petty officers and seamen.

In order to reduce power-plant noise in these submarines, toothed transmissions are excluded, and natural coolant circulation is used. Mechanisms and systems are installed on shock absorbers of new design. Sound-insulating compartments, air interlayers, and noise-absorbing coatings are specified. Small pumps, compressors and other mechanisms that have a low noise level are used. As a whole, this power plant, in the opinion of American specialists, will enable sailing at low-noise speeds that are higher than those of older type SSBN's.

According to American press reports, combat stability of Trident-system SSBN's is provided by reducing their noisiness, improving maneuvering qualities and improving self-defense equipment.

In addition to the ballistic missiles on Trident-system submarines, MK-48 torpedoes and the submarine variant of the Harpoon ASW missile have been specified.

Gyroscopes with suspended electrostatic rotor and laser gyroscopes have been developed for the new inertial navigation system for these submarines. An earth-satellite navigation system is used to correct the inertial navigation system. The precision of position fixing with its use, according to the claims of U.S. specialists, is 40-50 meters. In order to provide for shore-to-submarine communications, an ultrasuperlong-wave system of communications is being created.

The AN/BQQ-6 complex, which will include the AN/BQS-15 close-range active sonar, the AN/BQS-13 long-range active sonar, the AN/BQR-12 set, with special antenna, for detecting targets above the thermocline, and the AN/BQR-15 set, with trailing antenna, for listening for targets that are at stern course angles to the submarine, will be the main hydroacoustic complex. An AN/BPS-15 radar set will be installed on this submarine.

It is planned that operation of the complexes and other SSBN systems will be controlled by a computer, which is connected to the ship's general-purpose computer.

In the opinion of American specialists, the Trident-system SSBN's will be on combat patrol for 4-6 months, which will greatly raise the coefficient of their operational utilization, and it will be possible to replace crews and replenish reserves from transport submarines without surfacing.

The basing and repair point for the first 10 boats of this subclass has been set for the area of Bangor (Washington state). It is proposed to create a similar base on the U.S. Atlantic coast at Cape Canaveral (the state of Florida). Research is being conducted on the creation of fixed underwater bases.

Two programs for Trident-system construction have been developed in the United States.

The first program calls for the rearming of 15-16 "James Madison"-class SSBN's with Trident-I missiles instead of the Poseidon and the construction of 10 Trident-system submarines with Trident I or Trident II missiles, which are intended to replace "George Washington" and Ethan Allen"-class submarines. Execution of the program is planned for the end of the 1970's and the start of the 1980's.

The second program calls for the construction of 30 Trident-system SSBN's armed with Trident-II missiles and the rearming of 31 Polaris-Poseidon SSBN's with Trident-I missiles.

It is proposed to replace the Poseidon missiles with Trident-I missiles on 10 SSBN's at the start of 1979. The most convenient place for basing them is considered to be King's Bay.

Funds for developing a submarine smaller than the "Ohio" that will carry several Trident-I missiles have been appropriated.

According to foreign press reports, it can be expected that the U.S. will arm its submarines with about 700 ballistic missiles (besides the 1,000 ground-based intercontinental ballistic missiles).

An SSN armed with cruise missiles launched under water is being designed for operations against surface ships (with ordinary conventional explosives) and against shore targets (with a nuclear explosive). It is considered that both SSN's of special design and obsolete SSN's (for example, SSBN's of the "George Washington" class, after the removal of ballistic missiles therefrom), can be used as the carrier. The FRG is also developing a design for a diesel submarine with a displacement of more than 1,000 tons, to be armed with cruise missiles.

Trends in the Development of Nuclear Torpedoes and Other Submarines

It is presumed that the U.S. Navy possesses 90 nuclear attack submarines, the French Navy 20. Because aircraft carriers have weak combat stability and need protection, which is practically impossible to afford, given modern means of destruction, the American navy, according to foreign press reports, has undertaken to study the possibility of creating an underwater attack aircraft carrier.

In the 1960's the ASW submarine "Subplane," which, according to the concept of its developers, should have been a submersible aircraft with three jet engines, was developed. In the underwater environment it should have had an operating radius of 50 miles at a speed of 5 knots and a maximum depth of submergence of 22.5 meters. It was proposed that small electric motors be used for moving under water, with small storage batteries for the power source. The radius of action in the air would be 300-500 miles at a flight speed of 150-225 knots. The SS would weigh 8 tons, the payload 250-750 kg. But such a submarine was not created.

The U.S. Navy is doing work to create an SSN that is supposed to have a much greater speed and depth of submergence than existing (Conform) design SSN's, and to create submarines whose power plant will include fuel cells (it is considered that such a power plant will enable a low noise level for ASW submarines).

Foreign specialists assert that midget submarines will have special merits:

--they will be effective torpedo carriers;

--their detection will be impossible for radar, difficult for sonar; and

--low cost will enable large-series construction of them to be organized.

In their opinion, these boats should have high underwater speed, crews of not more than two or three people, two wire-controlled torpedoes, underwater sonar detection equipment, radio communications gear and an air-lock chamber for underwater exit of saboteurs. The possibility of delivering midget submarines on a self-propelled chassis to the shore for descent into the water is considered mandatory. The creation of new power plants, particularly installations based on fuel cells, is considered necessary.

In Sweden a power plant with a capacity of up to 200 kw, based upon hydrogen-oxygen fuel cells, has been developed.

In 1963 a midget submarine 10 meters long and 1.5 meters wide with a torpedo-shaped hull (made of fiberglass material) was tested. An electric motor served as an engine. The boat had an underwater speed of 15 knots, it was armed with two torpedoes, and its carrier was (hypothetically) an SSN. Midget submarines have been designed in Japan, and in the FRG they are already being built for civilian needs.

Research-design studies have been conducted in the USA, Britain, Italy, Japan and Sweden on the possibility of creating nuclear transporter submarines, the results of which indicated that their load-carrying capacity could reach 50,000 tons.

In the U.S. a design for a nuclear transport submarine, the "Engville," into which a load of up to 5,000 tons can be placed, has been developed. It would be 426 meters long, have a power plant of 200,000 hp, a crew of 6-8, a hypothetical underwater speed of 40 knots, and an operating depth (loaded) of about 60 meters.

There are reports about work plans to create a nuclear tanker submarine with these specifications: a load capacity of 100,000 and 5,000 tons; a power-plant capability of 15,000-24,000 hp, a buoyancy reserve of 8-13 percent, a speed of 20-40 knots, an operating submergence depth of 80-300 meters, and a crew of 24-56.

In the opinion of foreign specialists, organizing the haulage of troops under water, supplying them by means of naval underwater transports, and creating underwater tankers, ore carriers and bulk-load carriers are new areas for developing submarines.

The U.S. has developed designs for two nuclear submarine tankers for hauling crude oil from Alaska to ports free of ice. The specifications of the largest of them are: a load-carrying capability of 255,400 tons, a hull length of 310 meters, a beam of 52 meters, a draft (surfaced with full load) of 26 meters, a displacement (surfaced, fully loaded) of 353,000 tons and a submerged displacement of 370,000 tons, an operating speed of 17 knots, a power plant of 75,000 hp, two screws, an operating depth of submergence of 120 meters, and a maximum depth of submergence of 300 meters.

The main advantage of underwater transports and tankers over surface versions, in the opinion of American specialists, are: independence from the effects of weather and ice conditions, a reduction in haulage costs, and the possibility of providing for secrecy of haulage. The high cost of building constructional and overhaul structures and piers and operating difficulties are considered to be the main deficiencies.

Since deepwater apparatus for scientific-research purposes has reached the greatest depths of the ocean (11,000 meters), it can be supposed that submarine development can travel the path of greatly increasing submarine depths.

Trends in the Development of Weapons and Technical Equipment

Ballistic missiles for submarines, according to foreign press data, are being developed in the direction of increasing the flight distance and warhead yield, the number of warheads in the payload, and weight, length and diameter. It is expected that the payload of a single missile will be aimed at different targets.

Let us examine some of them.

The Trident-I is a 3-stage solid-fuel missile 1.88 meters in diameter, 10.38 meters long, with a launch weight of about 31,700 kg. Difficulties in developing the missile did not permit the planned flight range of 8,300-8,900 km to be achieved. The United States has now managed to obtain from it a flight distance of at least 7,400 km. This rocket has 8 warheads, the TNT yield equivalent of each being 100-150 kt (the MIRV-type payload). The probable circular error of the missile is 400 meters on a 7,400-km flight. The first Trident-I launch with a dummy warhead as the payload was made from a ground installation on 18 January 1977 to a distance of about 8,000 km. The rocket fell on a target 22 km in radius. The first submerged launch is expected to be conducted in 1979, after 25-30 launches from ground and water-surface installations.

The Trident-II D-5 missile, with a flight range of about 11,000 km, will carry, unlike Trident I, a MK 500 MARV payload, which is capable of completing a programed maneuver for penetrating the enemy's antimissile defense and is aimed at the target during the final segment of the flight trajectory.

A new multiple-charge payload for the Polaris A-3 missile, which will arm British SSBN's, is being developed. It will have 6 warheads individually aimed, with a yield of 40 kt each, and be capable of destroying targets at a distance of up to 70 km from each other, the total area of destruction being about 2,000 km^2.

"Submarine-to-air" class antiaircraft missiles for the air defense of SSN's have been adopted for armament in Great Britain, and they are being developed in the U.S. The missiles can be launched from periscope depth or from a surfaced position against low-flying targets (the Sabad and Slim designs). All of Great Britain's nuclear and some of its diesel submarines are expected to be armed with Harpoon missiles. A variant of the Martel antiship missile, which is launched from the torpedo tubes of submerged submarines has been developed in Great Britain. It will be fired in accordance with the submarine's GAS data and is aimed at the enemy by a radar system for missile homing.

The antiship guided missile SM-39 "Exoset," which will be fired from torpedo tubes, is being created in France for use with submarines.

Two Tomahawk cruise missiles (tactical and strategic), which are fired from torpedo tubes when depth of submergence of the submarine from periscope depth is less than 30 meters and have a flight speed of 880 km/hr, a launch weight of 1,360 kg, a diameter of 52 cm and a length of 6.4 meters, have been developed in the United States for submarines.

The missiles are fired from torpedo tubes as torpedoes are. After departure of the missiles from the water, their wings and tail assembly open up, the flight control system goes into operation, and the cruise engines are started.

The tactical cruise missiles with conventional charge, for firing at large surface targets at sea, have a flight distance of 560 km. The flight trajectory: altitude at apogee is 305 meters, during the cruise segment it is 5 meters. At the end of the cruise segment, the missile rises to an altitude of 100 meters. At this time the homing system is turned on. After locking onto the target, the missile descends to an altitude of 5 meters. Immediately before hitting the target, it gains altitude and dives at the target. The low altitude of flight enables the missile to evade detection by the enemy's observation equipment and reduces the probability of its destruction by his antimissile defense systems. During the cruise portion of flight the missile is guided by an inertial system. The direction of flight is given by the submarine's target designation system.

The inertial guidance system is mated to an active radar-homing head, which detects enemy surface ships at a sea state of less than 6, enables homing of the missile, both when the enemy maneuvers for purposes of evasion and when he uses his electronic countermeasures. When the tactical missile strikes the target the warhead is detonated by a delayed-action fuze. In case the missile flies above the ship, its warhead is detonated by a proximity radio-firing mechanism. Under salvo firing, there can be from two to four missiles in a salvo.

The strategic ruise missile is intended for the destruction of ground targets. Its flight distance is 2,400-3,200 km, and its flight altitude is: up to 305 meters at apogee, 15 meters above the water during cruise. Above land it flies in a terrain-avoidance mode at an altitude of 60 meters, or, if the terrain is hilly, at an altitude of 150 meters. The missile's flight altitude is provided for by a Tercom memory system and also by a barometric system and radio altimeters. At the final stage of the flight, the missile homes on the target with active radar or with an electronic-optical homing head or a spatially correlated radiometric system.

By the end of 1977 the U.S. Navy had launched 14 Tomahawk tactical and strategic missiles. At the middle of 1976 an experimental tactical missile had flown 1,100 km with a speed of 858 km/hr. Work is being done to create a new high-energy hydrocarbon fuel, the use of which can increase flight range by 20 percent, or, using boron hydride components, by 150 percent.

Work is being done in the United States to create a second-generation Subroc ASW rocket with improved characteristics under the code name "North Star." The possibility of creating a torpedo missile with a small-clearance torpedo instead of a nuclear warhead is being studied.

Development of the torpedo weapon in NATO navies is going in the direction of standardization and reduction in types of torpedoes. A trend toward arming submarines with remote-control torpedoes has been set. It is expected that torpedo speeds will be brought up to 200-300 knots. Work is being done to reduce the operating frequency of the homing equipment to 600-900 Hz and to cut the noise of torpedo mechanisms; this can double or triple the torpedoes' reaction radius, make detection of the torpedo by the target ship difficult, and reduce the effectiveness of a target imitator.

Instead of the MK-27 mine, which is in the armament, a new self-transporting mine that has greater advantages over it is being developed, to be planted from submarine torpedo tubes. (Compilation of the preliminary design was completed in 1968, but appropriations for continuation of the studies were not allocated.) The Quickstrike mine, in which remote control for activation of the fuze will, in the opinion of the Americans, make the mine more combat efficient, is being developed in the United States for laying from submarines, surface ships and airplanes.

In the United States, where many types of underwater sounds have been studied, special comparators have been created, by means of which the acoustic characteristics of noises that are received by a submarine's sonar complex can be compared and identified. The sound propagation conditions in areas adjacent to the ice edge of the Chukotskiy and Bering seas are being studied. Special attention is being paid to a study of the possibility of detecting submarines with low-frequency GAS and with high-frequency homing heads of acoustic torpedoes.

Sonar sets with very great operating range (with conversion from low to superlow frequencies, which possess the greatest propagation distances) are being created. This requires the placement of sonar complexes of great size on submarines.

Submarine sonars, in the opinion of U.S. specialists, will be developed in these directions:

--improvement of automatic means of target classification (work is being done to create a "self-teaching" Cybertron-100 computer);

--the creation of high-precision passive target-designation systems for torpedo and tactical-missile weapons;

--an increase in the operating range of complexes in the distance-measuring or echo-direction-finding modes; and

--improvement of underwater-sound communications and the development of methods for masking transmissions reliably under the ocean's noise background.

Further improvement of gear for hydroacoustic communications for submarines continues. Studies are proceeding in the area of research of the properties of sound propagation in the hydroacoustic communications channel. Methods for reducing the signal distortion caused by multiple-path propagation are being sought, and channel throughput is being studied. It is proposed that self-correcting codes and other methods of increasing the interference resistance of the communications be used.

New transmitting devices--deepwater receivers and emitters based on pneumatic principles of transformation--are being created in the United States. (An emitter, based on the principle of using a standing wave, with an underwater power of less than 1 watt, created signals on a frequency of 270 Hz that were propagated a distance of about 100 miles.) Since 1945 the equipment on U.S. submarines has increased on the average from 9.2 to 14.3 cubic meters in volume, from 4.7 to 131 tons (109 tons of it are antennas) in weight, and from $87,000 to $8 million in cost. According to plans, a new system of Navstar satellite radio navigation, which has great advantages over existing systems, should be completely ready in 1984. Since it is necessary for support of the Trident system, the program for its construction has been shortened by 1.5-2 years, under pressure from the navy command.

Trends in the Development of Control Facilities

According to a claim by U. S. Navy communications specialists, existing U.S. gear for radio communication with SSN's that are at a great depth does not completely answer the requirements laid on it. The Sanguine system, which is being developed, is considered the most promising (it is a part of the Trident-system program; it is based on the use of electromagnetic waves of extremely low frequency, which are propagated over very great distances and have small attenuation in the atmosphere and in a water medium). It is expected to be used for controlling submarines that are submerged. The Sanguine system should help to raise the combat capabilities of Polaris-Poseidon and Trident-system submarines.

The following requirements are placed on the Sanguine system:

--the provisioning of timely transmission of reports of extraordinary importance to submarines that are under water at any point in the World Ocean, under the conditions of enemy use of nuclear weapons;

--the capability to operate when the enemy is inflicting strikes by nuclear and conventional weapons;

--resistance to effects of deliberate interference; and

--survivability of the high comand's lines of communications with the transmitting center.

The total output power of the system will be about 10 MW, and it should operate in the 30-100 Hz frequency band. A portion of the system's transmitters will be placed underground at a depth of up to 100 meters. It is expected that the most successful antenna for submarines will be one that is towed outside the zone of its electromagnetic field.

It is planned to introduce the Sanguine system into operation in 1979, when the first Trident-system SSBN's go out on patrol. It is proposed to build the main center for the system in the state of Texas, and an auxiliary one in the state of Michigan. With creation of the Sanguine system, the problem of communication of the command with submarines that are at great depths apparently can be solved.

Reserve systems for controlling SSBN's are being created in the U.S. and France. For this purpose, transmitters for relaying commands transmitted to submarines are being installed in the U.S. on some ships of the reserve.

France has decided to use an antenna that can be raised on a balloon.

Communications-relay aircraft are a basic reserve for communicating with SSBN's. Ultrashort-wave, medium-wave, long-wave and superlong-wave radio receives and transmitters are being installed on them to relay reports sent to submarines from the CP or from earth satellites. The aircraft antennas are 8 km long.

The possibilities for two-way communication between submarines and the shore, using earth satellites as communications relays, are being studied. In 1976 the diesel submarine "Bonefish" (U.S.), sailing under water, transmitted messages and received information from a command post by means of a towed antenna and a buoy, communicating with the CP through the Marisat earth satellite on frequencies of 248-312 MHz.

Conclusion

Submarines have begun to play the major role in the navies of foreign capitalist states because they have proved to be capable of operating with greater secrecy than surface ships and they inflict surprise blows with mines, and later with torpedoes, against large enemy naval ships that exceed them severalfold in displacement, yield of weaponry and crew manning. These advantages have enabled submarines to execute more reliably the tasks of destroying the enemy's sea and ocean communications. Moreover, less expense is involved in their construction, their upkeep costs less, and in combat operations they have fewer combat losses of personnel. In wartime submarines have shown that they can operate for long periods in all parts of the World Ocean (except those covered with ice), without support, as a rule, from other forces, a fact that also lessens the cost of the tasks that they execute.

The effect of the combat activity of submarines on the course of armed struggle at sea and on land during world wars, and also on the development of navies, was reflected in the fact that they coped successfully with the following tasks:

--by destroying sea and ocean communications, they undermined the economies of their enemies; and

--by destroying naval combatants and the manpower, equipment and weaponry that the ships and craft carried, they caused difficulties for the enemy's combat operations on land and in defense of his sea communications.

The predominant position of submarines in navies has compelled warring states to create and rapidly develop ASW forces and equipment and to sharply change the tactics of surface ships and the organization of navigation. The appearance and development of ASW forces and equipment during the world wars, the development of their tactics and the tactics of large surface ships and changes in the organization of shipbuilding, in their turn, constantly required improvement of the TTE's of submarines and in the development of their tactics.

The experience of World War II and the postwar period of development of the U.S., British and French navies indicated that their diesel submarines did not have adequate TTE's for conducting combat operations under modern conditions. Therefore, these countries stopped building them.

Equipping American, British and French submarines with nuclear power sharply increased their underwater speeds and cruising range and underwater endurance, made it unnecessary to surface, reduced to a minimum the time spent at periscope depth, and increased the secrecy of their operations, their combat capabilities and their combat stability.

The arming of submarines with ballistic and ASW missiles, torpedo missiles and general-purpose homing torpedoes has advanced them to the strategic forces and made them the principal strike forces of the navies of the main capitalist states. Confirmation of this is the creation by the U.S. of the strategic underwater nuclear Polaris-Poseidon missile system and, later, the creation of the Trident system.

The development of submarines continues, following the path of increasing the yield, operating range and firing rate of their weaponry, cruising distance at high speeds, and the secrecy of operations as the result of an increase in the depth of submergence, a decrease in noisiness and the creation of sonar countermeasures gear. The range, secrecy of operations and fast action of their observation and communications gear are being increased. The precision of ship navigation and level of automation are being raised.

In addition to naval submarines, the appearance in mercantile fleets of submarine tankers and transports that can be used for transoceanic hauling is possible.

The development of submarines has promoted the departure from navies of certain types of ships or reduced their construction and created new types of surface ships that differ sharply in their configuration and principle of movement from ships that operated in previous wars.

The number of SSN's in the fleets of the main capitalist powers is growing. The number of tasks that they execute is being expanded, and their tactics are being improved.

Paralleling the development of submarines are the growth and development of ASW forces and equipment.

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Soviet submariners did very much for the victory over the Hitlerite aggressors during the Great Patriotic War. Here are just two examples.

On 30 January 1945 the submarine S-13 of the Red Banner Baltic Fleet (KBF), under the command of A. I. Marin, sank the German liner, "Wilhelm Gustlof," which had a displacement of 24,484 tons and was carrying 7,000 Fascists, including 3,700 highly qualified submariners, who were ready to make up the crews of 80 submarines. On this occasion, a three-day mourning was declared, the convoy commander was executed, and the commander of the Soviet submarine was declared the personal enemy of the Reich and was sentenced in absentia to the death penalty.

On 17 April 1945, 1,300 German submariners--officers, cadets and sailors (about 30 submarine crews)--were lost on the transport "Goyya" [transliterated], which was sent to the bottom by the KBF's Guards submarine L-3, which was under the command of V. K. Konovalov.

The Navy of the USSR and its underwater forces are being developed to have the capability to successfully defend our country's state interests and the interests of our allies--the socialist countries. It is always ready to ward off the blows of naval aggressors, including those of their submarines.

Nuclear weaponry has enabled our navy's submarine forces to become a part of the country's strategic nuclear forces.

Nuclear power imparts basically new qualities only to submarines, transforming them into truly undersea ships, which combine in the greatest degree such basic indicators of sea power as maneuverability, striking power and secrecy. The navy's submarines are also becoming full-fledged ASW ships, capable of detecting and destroying enemy missile-carrying submarines.

The characteristics of the new weaponry, the means of observation and nuclear power increase by far the combat capabilities of all forces of the USSR Navy. Right now our Armed Forces include a fully modern ocean fleet equipped with everything that is necessary for executing missions on the expanses of the World Ocean that are vested in it.

Our navy threatens no one, but it is always ready to defend reliably the state interests of the Country of the Soviets and of the whole socialist community and to cool down the ardor of the lovers of military adventures and the enemies of peace and the security of peoples.

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