

This introduction is repeated to be sure future readers searching for a single issue do not miss the opportunity to see what the Director of AIR ASW Technologies (Peter Verburgt) wrote.

## INTRODUCTION TO THE THEME: AIRBORNE ANTI-SUBMARINE WARFARE

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(Received December 15, 2013)

Anti-Submarine Warfare (ASW) is a critical mission area for the U.S. Navy and supports its interest in being able to operate unhindered in any ocean environment. Of the primary ASW platforms; submarines, ships, and aircraft; the aircraft alone operates outside the ocean environment. This feature promotes the development of ASW hardware unique to the airborne element. In addition, while the ocean's environmental principles remain the same for all platforms, the aircraft's agility and speed permit the exploitation of fields of sensors and, by default, multiple simultaneous acoustic propagation paths and active multi-statics. All of this serves to highlight the versatility of the airborne platform and makes it extremely friendly to technology enhancements.

Where is the state of the art in Air ASW Technology? To answer this question with perspective, I reviewed a U.S. Navy training video on Airborne ASW, a "how to" for operational personnel. What was described is what one would expect, i.e., an aircraft deploys a radio sonobuoy, the sonobuoy deploys a hydrophone sensor, and finally, acoustic data is transmitted from the buoy to an aircraft where it is analyzed for submarine signatures. The video offered a pretty basic description involving basic concepts and technology. The unusual aspect here was the date of the video, 1944. The aircraft involved was a Martin Mariner PBM-3 (Fig. 1), the sonobuoy, an AN/CRT-1, the Navy's first operational sonobuoy. The submarine was, of course, a WWII vintage diesel-electric.

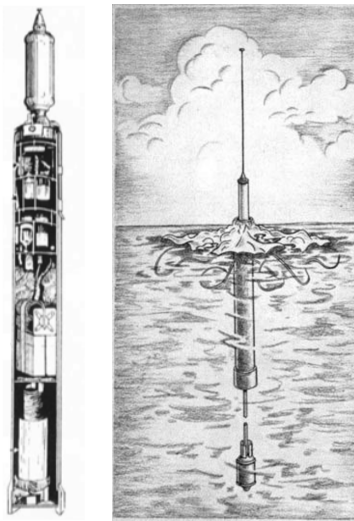


Fig. 1 – Martin Mariner PBM-3, circa 1944

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Report Documentation Page			Form Approved OMB No. 0704-0188		
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1. REPORT DATE <b>JUN 2014</b>		2. REPORT TYPE <b>N/A</b>		3. DATES COVERED <b>-</b>	
4. TITLE AND SUBTITLE <b>Introduction To The Theme: Airborne Anti-Submarine Warfare (U)</b>				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>Naval Air Warfare Center, Aircraft Division Mission Avionics Department Code 4.5X ASW Sensors Technology</b>				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release, distribution unlimited</b>					
13. SUPPLEMENTARY NOTES <b>See also ADC083063. U.S. Navy Journal of Underwater Acoustics Volume 62, Issue 3, July 2012., The original document contains color images.</b>					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			

The AN/CRT-1 sonobuoy (Fig. 2) entered operational use in June of 1942 and, in comparison with the Airborne ASW concept of today, it does not appear that much has changed. However, perception is not fact in this case. In the intervening seventy years, technology has advanced considerably and has touched every aspect of the aircraft's technique in conducting ASW operations. Today, aircraft such as the Boeing P-8 Poseidon (Fig. 3) fly higher, faster, and farther. The processing contained within the airframe is orders of magnitude more powerful, allowing the operators to simultaneously monitor large fields of sensors. The sensors, while still bearing the name sonobuoy, provide significantly more gain and are reliable, longer lasting, and adaptable to changing mission requirements. The AN/SSQ-101 sonobuoy (Fig. 4) is an example of that current-day state-of-the-art technology. Perhaps more importantly is our understanding of the environment and the interaction of the submarine within it. The intervening years have built an incredible knowledge base, thanks to a continued investment in the modeling, simulation, and data collection of acoustic propagation. Today, the types of sensors employed by the aircraft reflect a deep understanding of that operating environment and their required placement to accomplish a particular mission.



Cut-Away                      Deployed

Fig. 2 – AN/CRT-1 Sonobuoy



Fig. 3 – Boeing P-8 Poseidon

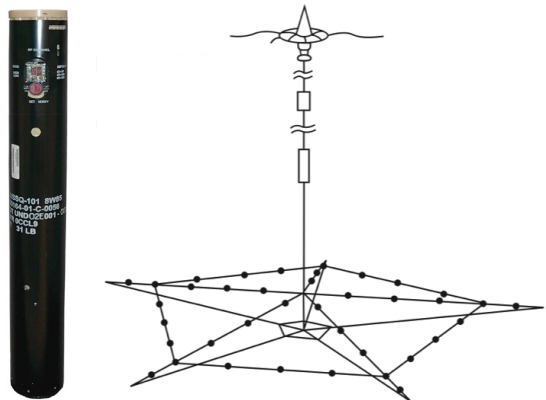


Fig. 4 – AN/SSQ-101 Sonobuoy

While conceptually the ASW operation remains similar, that is, the aircraft utilizes a sonobuoy to interface with the underwater acoustic environment, every other element reflects modern applications of emerging technologies and knowledge. Within this, there is also a possible glimpse at where next generation advances will be applied.

As in the previous three Air ASW theme issues of the JUA (1959, 1992, and 2000), the articles contained within this issue serve merely to touch on a few of the important advances currently being employed or researched. It is intended to publish this Air theme issue in two volumes, with this being the first of the two. Volume One contains papers related to the conduct of ASW missions using an aircraft as well as a look at alternate technologies, e.g., radar, magnetometry, electric field, and a non-explosive impulsive source. Volume Two papers encompass the current state of multi-static acoustics, including coherent projection technology, modeling/simulation, environmental sensing, automated/remote sensor field operation, and secure sonobuoy communications. Approximately twenty papers in total will summarize the stated topic areas.

Technology improvements are emerging at an ever increasing rate. Commercial interest, once a secondary driver, now is a primary driver that only helps to enhance the availability of such technology breakthroughs for military applications. Where might technology take Air ASW in the future is difficult to predict, but there are a few clues. The clues are not just technology based however. Computer chips will undoubtedly operate faster, integrated circuits will likely become smaller, but they alone will not drive the future direction for the Navy. I submit that the clues or roadmap to the future are embedded in cost, threat, environment, aircraft platforms, exploitables, as well as those breakthroughs enabled by technology advances. To expand just a bit on these:

- a.) "Cost" – This is an ever-important reality of the landscape today. Techniques to reduce system cost such as reducing reliance on expendables will be highlighted over those that are more costly.
- b.) "Threat" – There is somewhere over five hundred known submarines in the world today with over one hundred more in the planning stage. A number of these threats are very serious in their stealth and weapon delivery ability. Our ASW developments will be stressed by the improvements required to detect these threats.
- c.) "Environment" – Deep environments have a different ASW solution set from shallow littoral areas, and that includes not just the available acoustic propagation paths but the RF environment in which our sensor systems must operate. Denied area environment are yet another complication in search of a solution.
- d.) "Aircraft Platforms" – The Navy's newest platform is the P-8 Poseidon aircraft. It has a new expanded flight envelope over its predecessor. This offers new opportunities for ASW sensor systems to expand capabilities in synergy with the new platform. Beyond are opportunities for the burgeoning field autonomous aircraft (large and small sonobuoy size), and even beyond is the potential for high altitude airships and space based. Each platform exposes new technology potential.
- e.) "Exploitables" – Much is known today about acoustics and its application to ASW. As the threat submarine evolves, new exploitable signatures are likely to be generated. These signatures may or may not be detectable acoustically, so that added attention will need to be paid to alternate non-acoustic technology.
- f.) "Technology Advances" – Not to be overlooked, technology itself will continue to follow a progression of advances. Cheaper and smaller breakthroughs will lead to new generation of sensors with expanded ASW applications and perhaps capabilities.

The future is wide open in the area of Airborne ASW. The clues are there for directing the research, and platforms are awaiting enhanced capabilities.

It has been a privilege providing this introduction to the JUA Air ASW theme issue, and I look forward to this publication and those to follow with technologies yet to be developed.

I am grateful to all the authors who have provided the papers comprising the two volumes of this theme issue as well as to those who submitted papers but where space and time prevented their inclusion. I am especially grateful to the Office of Naval Research and Air ASW Systems Program Office, PMA-264, who sponsored most of the work covered by the included papers. Without your assistance and interest, this work would not have been possible. Thank you.

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