JOURNAL OF

THE AUSTRALIAN NAVAL INSTITUTE

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AUSTRALIAN NAVAL INSTITUTE

1. The Australian Naval Institute has been formed and incorporated in the Australian Capital Territory. The main objects of the Institute are:–

   a. to encourage and promote the advancement of knowledge related to the Navy and the Maritime profession.

   b. to provide a forum for the exchange of ideas concerning subjects related to the Navy and the Maritime profession.

   c. to publish a journal.

2. The Institute is self supporting and non-profit making. The aim is to encourage freedom of discussion, dissemination of information, comment and opinion and the advancement of professional knowledge concerning naval and maritime matters.

3. Membership of the Institute is open to:–

   a. Regular Members–Members of the Permanent Naval Forces of Australia.

   b. Associate Members–(1) Members of the Reserve Naval Forces of Australia.

      (2) Members of the Australian Military Forces and the Royal Australian Air Force both permanent and reserve.

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      (4) Other persons having and professing a special interest in naval and maritime affairs.

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4. Joining fee for Regular and Associate Member is $5. Annual Subscription for both is $10.

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As the Australian Naval Institute exists for the promotion and advancement of knowledge relating to the Naval and maritime profession, all members are strongly encouraged to submit articles for publication. *Only in this way will our aims be achieved.*

DISCLAIMER

In writing for the Institute it must be borne in mind that the views expressed are those of the author and not necessarily those of the Department of Defence, the Chief of Naval Staff or the Institute.

JOURNAL OF THE AUSTRALIAN NAVAL INSTITUTE (INC)

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OUR COVER

The front cover is a reproduction of an impression of an FFG-7 Frigate by courtesy of Defence Public Relations.

COMMODORE VERNON PARKER

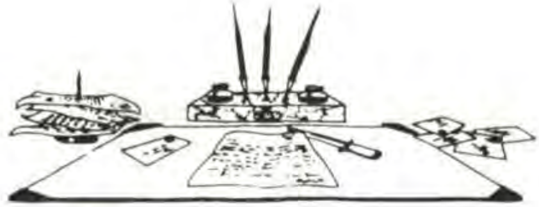
On 1st July 1977, our first President retired from the Navy at his own request and, since he could no longer continue as a Regular Member of the Institute, he became ineligible for office. As this requirement of our constitution is often misunderstood it ought to be made plain that Vernon was, and remains, an unbending proponent of this provision. Indeed, it originated with him.

So, any who may feel that the Institute may have been less than properly grateful to our first President, will, I hope, be reassured that he woud not have it any other way himself. His intention to remain as an Associate Member has been overtaken by the Council, which has since invited him to become an Honorary Life Member.

We are very much in Vernon's debt as our founder and first President. He has been a strong guiding force, undaunted by the difficulties of the early days before the Institute was formally incorporated, through the, at times, exasperating delays to become legally established and for the two years of the Institute's life so far. These early years have seen the faith that this was a worthwhile venture fully justified, but it has not been without its anxious moments; few would have known it from Vernon's confidence in the Institute's ultimate success.

We are now firmly established; our resources are quite slender but strong enough to sustain modest growth. It is quite an achievement, and so much of it is due to our founding President. We will miss his own special brand of coercion and the Churchillian flourish with the cigars, but his continuing association with the Institute is assured.

From all of us, Vernon, thank you.



CANBERRA CHAPTER NEWS

About 25 members and guests attended a meeting of the Canberra Chapter at the RSL National Headquarters on Tuesday, 5th July, 1977.

At the meeting Commander H.G. Julian DSC RANEM gave an interesting and, for some, nostalgic address titled "One Man's View of Naval Aviation–Past, Present and Future". As could be expected this topic provided the basis for an entertaining question period.

Among the members present was one of our distinguished Honorary Life Members, Admiral Sir Victor Smith AC KBE CB DSC RAN to whom the Chairman, Captain L.G. Fox RAN, extended a particular welcome.

The next meeting of the Canberra Chapter will be held at the unsual venue on Friday 28th October 1977 where Captain I.W. Knox RAN will present a paper titled "Law of the Sea–Political, Economic and Strategic Implications".

This meeting will take place on completion of the Annual General Meeting of the Institute which will commence at 1930.

AUSTRALIAN NAVAL INSTITUTE PRIZES – 1977

The ANI Council has decided to award the following prizes for Articles printed in Volume 3 of the Journal, that is in the four editions published in 1977:

The best major article: $75

The best minor articles (i.e. Shiphandling Corner, Make a Signal, Technical Topics, I Was There When . . . , Nobody Asked Me, But . . . , book reviews, etc):

- first prize $10
- runners up (two) . . . . $ 5

To be eligible, articles must have been written expressly for the Australian Naval Institute, and must be both original and accurate. The winning major article will be that which, in the opinion of the Council, makes the best contribution to the aims of the Institute, i.e. the advancement of knowledge and the exchange of ideas concerning the Navy and the maritime profession. The Council will give preference to articles which put forward new ideas and constructive comments.

Minor articles will be judged on their interest, readability, aptness and, where appropriate, humour.

Automated Command and Control Systems

Current and Future

BY CAPTAIN P.G.N. KENNEDY, RAN and COMMANDER O.R. COOPER, RAN

This paper was presented to the Canberra Chapter on Tuesday 5th April, 1977. (Captain Kennedy is serving as the Naval Combat Data System Project Director, and Commander Cooper is the Systems Engineer at the Combat Data Systems Centre in Canberra)

There will be many naval officers with better credentials than we to present a paper on this important subject. We do, however, share in common a passionate interest in the subject; thus the invitation to hold forth on it was more than we could resist!

At the outset we wish to make two important points. Firstly that we are constrained to present only unclassified material. Secondly that our presentation may in no way be construed as official Navy policy. Such material, facts and figures as we do present have been taken from a range of unclassified books and Defence oriented magazines.

We plan to deal with the subject as follows:

- Introduction, Definitions, etc.
- The Threat
- Current Command & Control Arrangements
- NCDS Today
- The Future
- Conclusions

Before proceeding to define the topic we would say only that our initial reaction on being asked to deliver the presentation was, "What's new about command and control?" Indeed there is nothing new about it at all–in principle. It is as ancient as warfare itself. As we see it, the basic principles have not in the past, and will never change. It is only that on-rushing technology in the Defence/weapons area must cause us to have our command, control and communications (C3) arrangements and facilities, "hardware" and so forth under continual review. For this reason, we accepted the invitation–and you will note that our approach is a philosophical one moderately larded with technology.

A current definition of command and control is: "An arrangement of personnel, facilities and the means for information acquisition, processing and dissemination employed by a commander in planning, directing and controlling operations."

From our viewpoint, this definition stands up well. Again, an official definition of a command and control system: "The facilities, equipment, communications, procedures and personnel essential to a commander for planning, directing and controlling operations of assigned forces pursuant to the missions assigned."

The difference between the above definitions is scarcely perceptible. To emphasise our standpoint we have come up with one of our own devising: "The means by which action data is automatically collected, processed, displayed, evaluated, disseminated and weapon deployment decisions made in real time".

You cannot fail to notice the emphasis on *automation* and real *time*.

Conceptually, Figure 1 shows how we see the C3 system, I repeat *system*. It is important to note that the people are integral to the system, not outside it. Note also that the data link spans both "hardware" and "software".

We would stress that this pictorial concept, and indeed our definition of the automated system, are emphatically not confined solely to the ship unit. They apply equally to a C3 system at

ESSENTIAL ELEMENTS OF AN AUTOMATED COMMAND AND CONTROL SYSTEM

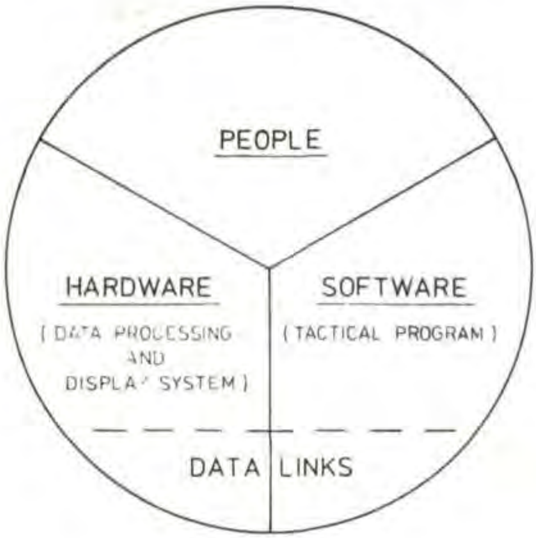


FIGURE 1

CNS level, in the Maritime Headquarters and at sea, in the air, surface or sub-surface and the linkage between all these units at their respective command level. A good deal of our subsequent presentation relates to the ship unit. The need to have you home before morning precludes exhaustive discussion of C3 at all levels. We would ask you simply to bear in mind that the same principles apply at all those levels, to all those units.

Before we get to the central strand of tonight's address, we feel we must establish the case for having automated command and control systems at all. We will assuredly not ask you to take this for granted. We first must look at the threat.

THE THREAT

Most discussions of "The Threat" usually start with the political and geographical factors which have the potential to involve the Nation in military operations. Except for one aspect, such factors are not relevant to tonight's address.

The one exception is what we would like to call the danger of surrogate or vicarious warfare. We have all seen recent examples in South East Asia, the Middle East and even Africa where major military powers have provided modern sophisticated weapons to industrially backward nations.

The current state of technology is such that many weapons are now highly lethal, very reliable and simple to operate so that even poorly educated people can use them with devastating effect for as long as the patron nation is willing to keep up the supply.

As vicarious wars are a relatively safe way for major nations to flex their muscles and test their latest conventional weapons without themselves becoming directly involved, we predict that the present trend will continue. As a consequence, if there is any possiblity of our Navy ever becoming involved in armed conflict, even with a minor backward nation, we believe we must be prepared to defend ourselves against modern conventional weapons from the arsenals of the major military powers.

A further consequence of vicarious warfare arises from the capability of modern satellite surveillance systems. According to at least two journals[1-2] it is now possible to keep surface vessels under constant surveillance regardless of cloud cover. Although at present only a few nations have the ability to launch satellites, unclassified reports of the 1973 Arab-Israeli war indicate that we would be most unwise to assume that one of the major powers would not make satellite surveillance information available to any lesser power with whom Australia may be in conflict. In such a situation the opposition would have the advantage of surprise—a basic principle of war.

We would now like to return to the array of conventional weapons which are likely to pose problems for surface ships. For this review we have grouped them on the basis of their launching platforms. Firstly, consider the threat to surface ships from submarines.

The Submarine Threat

Submarine weapons include mines, torpedoes, and missiles. Although the mine is a most important weapon, defensive measures are unique and not relevant to this discussion and, therefore, we move on to the torpedo. Modern submarine torpedoes can be fired from long ranges. They are fast and run quietly and, therefore, don't leave the surface ship much time to take appropriate avoiding action. Even though the threat is beneath the surface, the torpedo is effectively an anti-ship homing missile.

The principle submarine anti-ship weapon today, and for the forseeable future, is the missile launched from beneath the surface, such as the American Sub Harpoon and the Soviet's SSN-7. Also, according to the International Defence Review[3], the British abandoned a project to produce Sub Martel and the French are considering a Sub Exocet based on the MM39 surface-to-surface version.

We shall return to the performance of these missiles later because we would now like to move to the threat to surface ships from other surface vessels.

Surface Ship Threat

Traditionally, surface ships have attacked other warships with guns and torpedoes but today no modern warship carries such weapons for this purpose. Initially they were superseded by surface-to-air missiles with a surface mode capability and more recently by low flying surface-to-surface missiles of which there are many examples. The Soviets were the first in the field with the now obsolete SSN-1 Scrubber.

This was quickly followed by the SSN-2 Styx which was demonstrated with dramatic effect when the Egyptians sank the Israeli destroyer *Eliath*. Others such as the longer range SSN-3 Shaddock, the SSN-9, SSN-10, and SSN-11 followed in rapid succession. In the West we have Exocet, Harpoon, the Italian Otomat, the Swedish RB08A and the only other SSM besides Styx to be used in action, Israel's Gabriel. While nearly all of these missiles are, or will be fitted in larger ocean going warships, the greater number will be found in smaller coastal defence vessels.

The nature of these missile systems makes it relatively easy for them to be installed in merchant ships and we could well see a revival of the notorious Q-ships of a bygone age. In a regional conflict which does not affect the rest of the world's merchant shipping, Q-ships armed with SSMs would be a major problem for the RAN.

Another variation of the surface launched anti-ship missile would be to place it ashore in a coastal defence role, such as Sweden does with the RB08A. This would virtually preclude both amphibious assault and Naval bombardment against a defended coast. We shall return to the performance of these missiles after we have dealt with the threat to ships from aircraft.

The Air Threat

Surveillance aircraft or shadowers are another unique problem but as they only threaten ships indirectly we shall not discuss them further. Of course, if the shadower is armed and makes an attack he ceases to be a shadower and becomes just another attacking aircraft. Attacking aircraft have three choices of anti-ship weapon namely bombs, rockets or missiles.

The use of free falling bombs and rockets requires the attacking aircraft to come within the defence perimeter of most modern warships and therefore we dismiss them as a threat. However the recent advent of "Smart" bombs may have altered this situation. Smart bombs can either be TV or laser guided or infra-red homing and are released from relatively long ranges. From the defending ship viewpoint they will appear like a flock of small missiles and present quite a problem for the ship.

Lastly, aircraft could carry a more conventional anti-ship missile such as Martel, Harpoon and Exocet or either the Soviet AS-4 Kitchen or AS-6.

In summary, we consider the prime threat to surface ships, regardless of the launch platform, is some form of guided or homing missile.

Missile Performance Parameters

Although the characteristics of the various anti-ship missiles already mentioned vary greatly, some minimum performance parameters can be identified and future trends predicted. For instance, early missiles such as Styx were subsonic, but many are now at least transonic and some are definitely supersonic. The Soviet SSN-10 fitted in the Kara, Kresta and Krivak classes of ship are reputed to fly above Mach 1, while the air launched AS-4 Kitchen travels at over Mach 2[4]. Current models can all be launched at or beyond the radar horizon range of most surface ships and, of course, sub launched missiles can pop up without warning well inside radar horizon range.

Most missiles fly trajectories which, if not for the entire flight, at least for the final phase, are just a few metres above the sea. Older air launched missiles and all surface-to-air missiles used in the surface-to-surface role have steeper angles of attack, as also do "Smart" bombs. Missiles have a small radar cross section making initial detection even more difficult. All missile launch platforms can carry a number of anti-ship missiles which could be launched in rapid succession.

An attacking force would be capable of co-ordinating its attack so that missiles approach the surface ship from different directions at roughly the same time. At this point it is worth noting that one journal[5] reports that during their Ocean 75 exercise, the Soviets rehearsed a world wide simultaneous missile firing in which all units managed to fire within 90 seconds of each other!

In summary, a ship under attack is faced with the prospect of defending itself against multiple high speed missiles coming from different directions simultaneously. Even if the ship had warning of the impending attack, which cannot be assumed, the missiles, particularly the low flyers, are difficult to detect until quite close to the ship. Even with the best defence systems available the problem for the surface ship under attack is one of reaction time.

Reaction Time

We have tried to quantify reaction time by the use of Figure 2 in which time, in minutes to go before impact, is plotted against initial detection range for different missile speeds. This graph could be produced by any school boy.

Without defining the radar horizon range it can be easily deduced that at best the defending ship has about 2 minutes in which to react and destroy or decoy the attacking missile. We venture to suggest that in reality she has considerably less than one minute. This would not be too bad if the defender was a single ship with a single incoming missile but a force under a co-ordinated attack is a significantly more complex defence problem. Furthermore, present trends in technology can only lead to the conclusion that future generations of missiles will fly faster, lower and be even more difficult to detect and that smart bombs will become even smarter.

EW Environment

To complicate the defending ships' problem even further we must consider the EW environment. Electronic warfare was used extensively by both sides in Vietnam and the Yom Kippur war with notable successes and failures[6]. It must be assumed that further developments in EW have been made by all major military powers and that in any future conflict EW will play a major part. Although EW can provide additional defence for the surface ship under attack, the point we wish to make is that its use by the attacker must add to the confusion for the defender and effectively reduce the time available for reaction.

TIME TO REACT AGAINST ANTI SHIP MISSILE

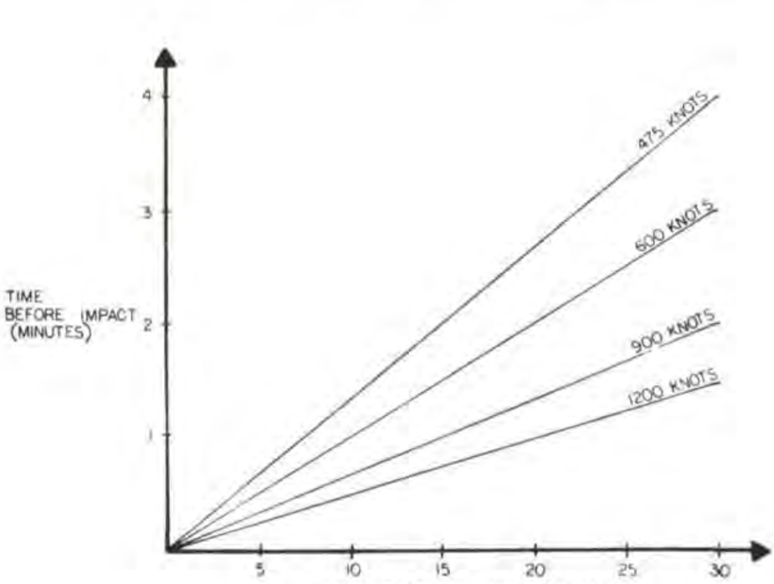


FIGURE 2

Summary of the Threat

In summary, we consider there would be a significant threat to our surface forces in any future conflict, even one with a nation other than a major power. The opposition could well have knowledge of our whereabouts at all times and thereby have the adavantage of surprise. It is likely that any opponent would possess sophisticated anti-ship missiles and EW equipment and would co-ordinate his attacks. The net result is that if ever our surface ships come under attack they will probably have only a few seconds in which to react to defend themselves.[7]

CURRENT COMMAND AND CONTROL ARRANGEMENTS

With the threat in focus it is logical now to examine existing conventional (that is non-automated) command and control systems at sea.

Figure 3 depicts the Operations Room (or Combat Information Centre) of a typical conventional destroyer. What you see here are the terminals, if you like, of the various stand alone sensor and weapons systems with which the ship is equipped. Note the gap between the air detection area and the anti-air warfare sub-compartment. This gap is closed by a sound powered telephone (manual interface) between the two areas. The detected air target is also displayed as a symbol on the tactical air plot and moved by hand of sailor as fresh positional information is passed by voice. By the time the command has seen and assimilated the information it is stale and possibly inaccurate. Again may we remind you of the speed of the threat we have defined. This anti-air warfare example is common also to the electronic warfare, surface and anti-submarine warfare areas. Note also the gap between the Operations Room and the Bridge. Whilst most of the C3 and weapon control gadgetry is within the Ops Room, the Bridge (and Officer-of-the-Watch) has a vital role to play. The safe conning of the ship, aided by human eye, are at once its prime responsibility and principal asset. To play its part effectively the Bridge team must have a close interface with the Ops Room team. All too often

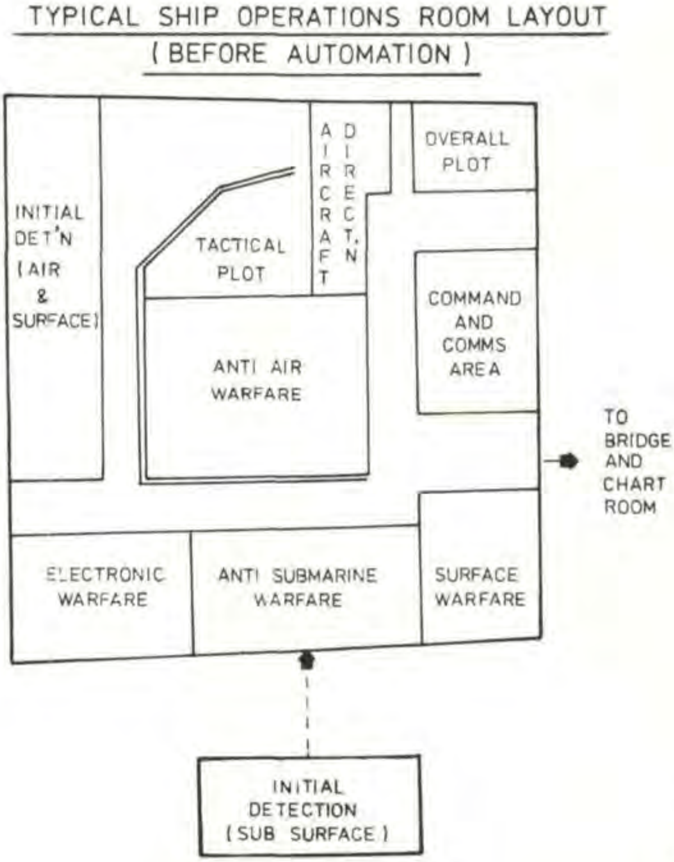


FIGURE 3

in practice (heat of the action) the Officer-of-the-Watch is the "forgotten of God". This physical interface is the sound-powered line or intercom—when it is remembered and used.

Back in the Operations Room we see that the various facets of fighting capability are compartmented or in functional areas. In addition to stale and often inaccurate data, manual assessments of the threat are made separately in each area—correctly or otherwise. Because the Commanding Officer cannot be in all places at once he must perforce delegate much of his authority. In each warfare area, manual decisions and options to counter the threat are made independently by delegates. Manual re-assessment is made in the event of changing circumstances. Manual (voice) communications of decisions are passed. It all adds up to lost time, stale data, subjective and insular decision. Faced with more than one type of threat concurrently just where would you position yourself as Captain? Just how would you get it all together? Just which threat is paramount at any one moment?

By now you will have perceived the corollary to the C3 dilemma in the conventional ship in the missile area—no amount of resource expended on weapon improvement in any one area will yield commensurate return in improved fighting capability unless the C3 system can properly accommodate it and thus deploy it to its maximum effectiveness.

In another form of words, the most super-smart, sophisticated, lethal weapon will avail nothing unless it can be deployed at the right moment in the proper circumstances.

Admiral Gorshkov[8] sums up this vital point more formally: "Delay in the employment of weapons in a Naval battle or operation inevitably will be fraught with the most serious and even fatal consequences".

The argument thus far has been down in the single unit Ops Room level. Let us elevate the discussion to the Fleet or Force Commanders level. His C3 arrangements again suffer from all the limitations already described, with one important difference. He is constrained to make his decision and dispositions from data inputs external to his flagship—hence his data is just that much more stale. Where there is greatest need for rapid and reliable data we find it most stale and most liable to corruption. Dare we suggest he may on occasion be frustrated and confused.

Against the threat posed, our conclusions are: Firstly—in the era of the Mach 2 missile, conventional command and control arrangements are just not good enough. Secondly—improvement of existing sensor/weapon sub-systems is nugatory unless accompanied by a matching improvement in the command and control system—thus allowing valid real time decision and response.

NAVAL COMBAT DATA SYSTEMS TODAY

The earliest attempts to overcome the deficiencies just outlined were made in the USA and the UK about 15 to 20 years ago. Since then the USN has developed a whole family of Tactical Data Systems and the RN, the ADA, or Action Data Automation Systems, based on high speed general purpose digital computers. Also since then most other NATO Navies have either bought derivatives of the American TDS or are in the process of developing their own systems. It is assumed that similar activity is in progress in the Warsaw Pact Navies. It is also significant that a number of non-European countries have recently acquired systems from one or other of the major powers.

The Australian Naval Combat Data System (NCDS) is based on the Tactical Data System fitted in some USN Charles F. Adams class guided missile destroyers. Our first system was installed at the Combat Data System Centre here in Canberra and became operational in May, 1974. By mid 1975 our second system had been fitted in *HMAS Perth* at the US Naval Shipyard, Long Beach, California. Another system is now being installed in *HMAS Hobart* at Garden Island Dockyard and the fourth system will go into *HMAS Brisbane* at Garden Island next year. Thus by 1979 we will have one system ashore, three systems at sea and a significant body of NCDS knowledge and experience. The Tactical Data System in the FFGs we are buying from the USA is very similar to our DDG NCDS so that by the early 1980s nearly half our destroyer fleet will have automated command and control systems. We will discuss some of the features of the RAN's DDG NCDS starting with its functions.

NCDS Functions

The functions of NCDS may be summarised as follows:

a. To gather tactical data from all shipboard sensors and external sources and sort, correlate and identify them.

b. To display the data in real time to enable command assessment and action as and when required.

c. To either evaluate the various threats relatively and decide appropriate responses or at least assist the command with these functions.

d. To co-ordinate optimum utilisation of available defence systems and monitor their performance.

e. To continuously exchange real time tactical data with other units of the force.

In order to perform these functions the system makes use of the same three essential elements you saw earlier (Figure 1). We would now like to discuss each element in more detail as it applies to NCDS, starting with the hardware.

Hardware

The NCDS equipment consists of three major sub-systems:

a. The Data Processing sub-system
b. The Display sub-system
c. The Data Communications sub-system

The Data Processing sub-system consists of the AN/UYK-7 digital computer and peripheral devices which enable it to interface with other components of the system.

The UYK-7 computer is a highly reliable, random access memory machine which performs many operations in parallel and has a high operating speed. Memory capacity depends on the configuration of the machine, of which there are many different versions. In the RAN configuraation the memory is adequate and it can be expanded if additional memory is ever required.

The Display sub-system consists of a number of operator PPI consoles known as multi-function displays and an array of back room equipment which switches and processes raw sensor data and generates symbols for the displays. It also includes simulation equipment for on-board training.

The displays provide the means for human operator participation in the system. In addition to the normal PPI controls, each operator has a track ball entry unit for controlling tracks and a computer controlled action entry panel which enables the operator to rapidly select modes of operation, control actions and respond to changing situations.

The third hardware sub-system is the Data Communication system which consists of a high speed data link for exchange of tactical data between ships and aircraft in a force. The components of this sub-system are a radio transceiver, a unit to interface the transceiver with the computer, a crypto device and last, but not least, the software to both control its operation and form the data for exchange.

Software

Mention of software brings us to the next element in Figure 1. The hardware and the operator cannot function without a programme in the computer. In NCDS there are two main categories of programme–the operational (or tactical) programme and test (or maintenance) programmes. The latter group is self-explanatory. Test programmes enable testing of either single equipments, sub-systems or the entire system and its interfaces with other ship systems. These programmes are used to quickly locate faults and confirm system operability.

The tactical or operational programme is the new element which makes NCDS different from earlier generation command and control arrangements. It embodies many of the ships' fighting tactics and procedures which previously were recorded in books and had to be learned and remembered by the command team. It is unemotional and not forgetful. Once a proven set of procedures is embodied in the programme it will perform them relentlessly without ever becoming tired or confused. It also attempts to take over both complex manipulations and routine repetitive tasks from the human operator, thereby giving the command team more freedom and time for assessment and decision making. We said "attempts to take over from the human operator" because it is not yet a perfect world. This brings us to the people segment of Figure 1.

People

Although for many threatening situations NCDS is capable of controlling a complete sequence from target detection to target destruction with the only human action being to press the fire button, it cannot yet cope with every conceivable situation. Therefore man still has two important functions to perform. Firstly, to specify and write better programs and secondly, to intervene in shipboard operations when and where necessary. Taking these in order, the primary purpose of the Combat Data System Centre is to improve and adapt operational software to meet both unique RAN requirements and the ever changing tactical situation. Thus more than ever before, people ashore, through the operational programmes they produce for ships, have a major influence on the performance of ships in a hostile situation.

Although the efforts of the software designers may simplify the task of the operators at sea and even reduce their numbers, with the present generation of systems human involvement will remain an essential ingredient. Man still has the important roles of monitoring system operation and intervening when unforeseen situations arise. Another important function for the man at sea is to observe the system performance and feed back recommendations for improvements to the programme. It hardly needs to be said that both these groups of people need extensive training which involves additional people.

Advantages

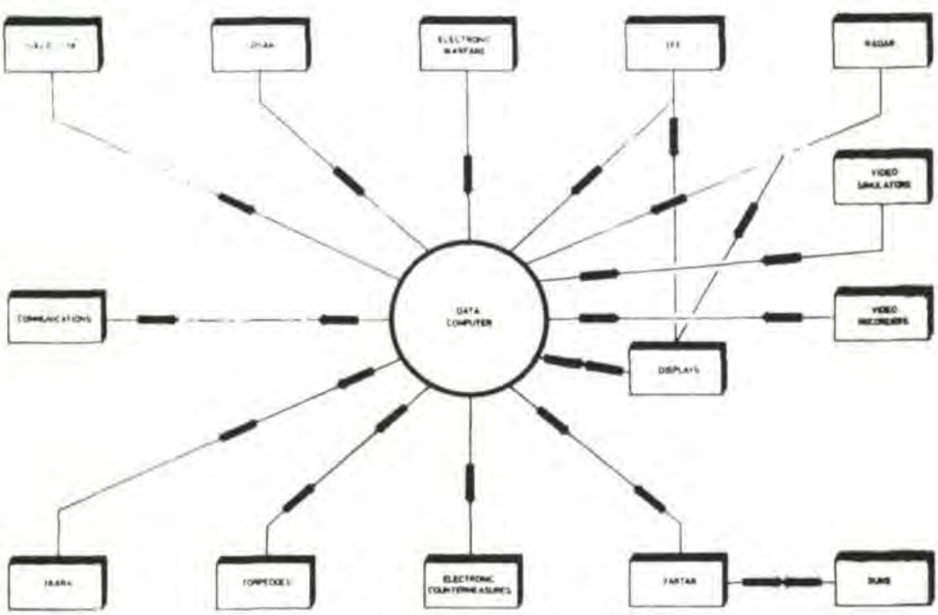
We hope from what has been said so far you can agree that NCDS is a significant improvement over previous arrangements in RAN ships. Firstly because it is a system designed to present tactical information to the command in a co-ordinated way, thereby facilitating rapid decision making. In this context we use the word command not only to mean the ships command team, but the force commander. The data link enables him to be automatically kept aware of the tactical situation as it develops. A second advantage of NCDS is the definite improvement in reaction time from initial detection of targets to engagement which, in view of the threat discussed earlier in this address, is significant. Although there are many other advantages, the only one we would mention is the inherent flexibility of the system for change. If you consider the computer as the heart of the system, then the software is the brain and the facility to modify this brain provides enormous potential for improvement. This point alone is a great advance on the old "hard wired" systems.

Limitations

Our enthusiasm for NCDS shouldn't be taken to imply that it doesn't have limitations, of which we will mention some of the more significant ones. Firstly, in spite of recent improvements, operators still have too many mundane tasks to perform and there is still room for confusion and error. In time these problems will be gradually eliminated. As shown in Figure 4 the system interfaces with nearly every weapon and electronics system in the ship. Because of the age and technology differences between NCDS and most of the other systems, some of these interfaces are primitive. One even requires a man to translate via a keyboard and digital read out. A related problem is that when it becomes necessary to modify or replace any of the systems which interface with NCDS it is essential that the impact on NCDS software and software documentation, as well as the hardware, also be considered. Although we stated earlier that the system was flexible for changes associated with changing tactics, software and documentation changes due to new interfacing requirements can often be both difficult and expensive.

A major problem at the moment is that not all our ships and aircraft are fitted with systems compatible with NCDS and its data link, and special interim arrangements are necessary for automated and non-automated ships to work together. Because NCDS introduces new concepts and procedures and to date few people have had the opportunity of gaining in-depth practical experience, we have a communication gap between the "Haves" and "Have-nots" and a large training task. It is hoped that in a small way this session tonight will help bridge this gap.

In summary, we believe automation of Operations Rooms has already produced major advances in reducing reaction time and countering the threat of the anti-ship missile.



NAVAL COMBAT DATA SYSTEM - CONNECTION WITH OTHER SHIP SYSTEMS

FIGURE 4

HMA ships BRISBANE, HOBART and PERTH in close company (see page 9 for programme of their NCDS fit).
—Defence Public Relations

THE FUTURE

Much more could be said about NCDS and other similar systems in existence today but the title of this address requires us to look into the crystal ball.

There are two broad avenues along which we see development proceeding. Firstly, we expect major developments in weapon and electronic systems primarily due to advances in digital technology and secondly we predict significant growth in software and systems design. This second avenue will have a resultant effect on our organisation and procedures. We deal first with the technological advances.

Processors

There can be no prize for predicting that digital computers will become smaller, faster and cheaper, but the effects of this trend warrant further analysis. Large or mainframe computers such as the UYK-7 are already compact, fast and do their job admirably. The only real incentive to supplant them arises from their high cost. We predict that it will be some time before smaller machines with comparable capabilities will be available for significantly less cost and therefore, the UYK-7 will be with us for a long time.

The same cannot be said for the mini-computers now entering service. Minis are significantly smaller and cheaper than the UYK-7, but their capability is also much less. To compare the two is like comparing short haul DC9 aircraft with the 747 Jumbo. They are both very good aircraft but designed for different purposes. The mini-computer, even before it becomes widespread, is about to be superseded in many applications by the micro-computer which will have a comparable capability, but be smaller and considerably cheaper. The arrival of the micro will open up a whole new range of applications and options. We foresee micro-computers proliferating throughout all facets of Naval warfare. They will permit automation of command, control and communication functions to an unprecedented degree. They will be built into individual sub-systems which will then be capable of working either under the control of a central processor or autonomously.

Displays

Turning to the future of display consoles, existing technology will permit development along three parallel paths. Firstly, we see the introduction of small data terminals consisting of either a plasma or liquid crystal display and input devices such as a keyboard, switches, light pen and the like for a human operator to occasionally communicate with an otherwise autonomous computer controlled system.

For applications which require constant monitoring and frequent human participation, we see the introduction of a standard all purpose console. This device will be completely flexible. It will be capable of displaying raw sensor data from any source in any format such as PPI, X-Y plot and so forth. The same console will also be able to display all computer controlled symbology including graphics, either superimposed on the raw sensor data or separately. And finally, the same display may be used as a TV, low light or infra red scanner.

The third advance in displays will be in large screen displays. There are a number of devices in the final stages of development which will permit the information from the face of a small PPI to be projected onto a large vertical screen under daylight conditions. The most notable of these devices is the liquid crystal light valve which promises to result in a compact, low cost projection system. It will become possible to connect it to a command and control system such as NCDS and display to a large audience the tactical situation in real time. Moreover, it will even have the facility to show different pieces of information in different colours so that hostile tracks could always be in red, whereas friendlies would be blue or some other suitable colour.

Systems

Our thoughts about a distributed arrangement of computers combined with the flexibility of future displays lead us to question the concept of the Operations Room and to wonder whether it will be needed in the future. As we know it today, the Ops Room is a highly vulnerable concentration of important people and equipment which would be much safer if distributed throughout the ship. Also, large screen displays for daylight viewing would permit the Captain to return to the Bridge. It would be ironical if the automated systems designed to solve the problems of the Operations Room resulted in its elimination from ships in the future.

So far in this presentation, we have concentrated on the problems of command and control in a single ship and how an automated system, such as NCDS, can improve its chances of defending itself both now and in the future. Before we conclude this presentation we feel we must address the matter of command and control at the various levels of command, from the local task force commander through joint service operational commands up to the national level. We must also keep in mind the potential need to operate with allies at all levels of command.

These higher levels of command must be able to marry intelligence data with real time tactical data from the scene of operations, assess the situation, identify the threats, quickly decide appropriate responses and then communicate their decisions to all units involved, whether they be units at sea, men on the ground or aircraft. Local area commanders must be able to co-ordinate their forces quickly to respond to changing situations and so on. We suggest that except for the physical distances involved, these problems are identical in nature to the internal ship command and control problems discussed earlier in our address. We also suggest that the solutions must be a hierarchy of systems, like NCDS, at each level of command and that all must be tied together by a common compatible communication system. In other words a C3 system of Command, Control and Communications. In case there are any doubting Thomases, we would like to expand on this proposal.

The Pacific Defence Reporter of February, 1977 contains a description of the Jindalee Project to establish an over the horizon radar in central Australia. It also mentioned alternative surveillance systems such as satellites and airborne early warning systems. While we agree wholeheartedly with the need for such surveillance systems, they are of no use whatsoever if the information they gather is not quickly disseminated to all forces and levels of command. Without elaborating, there are other sources of intelligence which must also be disseminated quickly, to be of any value.

Isolated intelligence data is seldom of use unless married with other intelligence and tactical data. There are numerous books describing how this was done during World War II and we suggest that our methods haven't improved much since then. Manual correlation is extremely difficult and slow and we can no longer afford the delay. This whole process is begging to be automated. We would agree that not all levels of command need or could use all the raw data which could be flying around the communications networks. There will be a need to filter it and present it in the most useful form. Different levels of command will need different data in different display formats. Even with filtered data, the commander at every level is still likely to be confronted with a bewildering array of options and very little time in which to decide. The present generation of systems can help him make his decision and automatically communicate his decisions to his subordinates. However, he has no way of testing his decision other than in the field, and by then it could be too late to correct a mistake. He needs a system with a "what if" capability. This is one in which the commander merely proposes a response to a developing real scenario and the computer predicts the result. If the commander doesn't like the answer he can modify his decision until he achieves the optimum strategy which he can then put into effect.

Organisation

None of the above predictions will be possible if we don't have compatibility in software and in data message formats throughout the entire Defence Command, Control and Communication network. There is nothing to be gained and much to lose by individual groups within each service doing its own thing to improve C3 arrangements without heed to the total picture and their place in it. It is of concern that there is no identifiable organisation within the Defence Department to set the policies and write the technical specifications needed to ensure that our C3 system will hang together and to avoid the mistakes already made in both commercial and military systems overseas. The technology is available, the most pressing need at the moment is for a matching organisation to make it happen.

CONCLUSIONS

The digital computer is, of course, essential to the automated command and control system. It brings with it software capability of great potential and flexibility. It allows change to accommodate one's own latest procedural and tactical requirements. It has the flexibility to adapt to changing enemy tactics or hardware. To maximise this overall capability one needs one's own "software house"—the RAN has it in the CDSC. More specifically, our conclusions are:

a. We confidently expect an ever heavier electronic warfare environment, more clever weapons and ever diminishing reaction time; all factors demanding automation of our C3 facility. The Naval Combat Data System is the first long step in the right direction. Significantly, it embodies the potential for continuing development.

b. Our C3 arrangements have in the past tended to be diffuse. In the relentless pursuit of better sensors and weapons, weapon-oriented functional staffs have tended to ignore the C3 requirement. Only with cohesive organisation ashore and afloat will the full potential of our afloat weapons systems be realised, more particularly in the sudden crisis situations prevalent in the world today.

Lest you think that we are too critical of our own Navy we commend to you a "Review of Department of Defence Command, Control and Communications Systems and Facilities" carried out in February, 1977 by the US Committee on Armed Services (House of Representatives). This unclassified report[9] was very critical of the then US facilities, organisation and material. It gives us much food for thought. Above all it gives C3 its proper emphasis and primacy. In the past we have from time to time been forgetful of its proper place in the overall scheme of things.

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FROM THE EDITOR

I hope you will notice that in this edition the majority of articles are well-illustrated with appropriate photographs or impressions. This is entirely due to the fact that, for the first time since the inception of the Journal (some two years ago), we received copy well in advance of printing deadlines.

This early reception of copy permits the editorial staff time to research the articles, select those which will make a balanced Journal and obtain suitable photographs or illustrations from the various sources available to us. Potential contributors can therefore play a large part in the quality of the Journal by keeping us fed with a steady supply of material. An added incentive is, of course, the prize money, details of which are described on page 3. If an article is not printed in the first edition after receipt by the editorial staff it does not mean that the article has been rejected; it is being kept for a future edition.

Surprisingly the one area where there is a dearth of copy is in Letters to the Editor. I am sure you cannot all agree with the arguments propounded in all of our articles. I hope therefore we will hear from you in the future.

— EDITOR

If a member of a ship's company is injured in an accident a signal has to be made informing the appropriate authorities. The signal has to follow a set format which contains details of the sailor concerned, nature of the injuries, details of the accident, next-of-kin information etc. The following injury report was signalled by a ship at sea. (The ship's name, date of the accident, and personal details of the sailor and next-of-kin have been disguised for obvious reasons).

FROM: HMS NONESUCH
TO: AREA FLAG OFFICER
INFO: DEFNAV CANBERRA
COMAUSFLT
SUBAREA COMMANDER

1 RI 1602 REPORT OF INJURY
2 SAILOR BLOGGS OFFICIAL NUMBER Z99999999
3 0930K 31 JUN 77 HMAS NONSUCH
4 DISLOCATED JAW WHILE YAWNING
5 NOT APPLICABLE
6 DISLOCATED JAW
7 NOT SERIOUS
8 INTEND MEDIVAC AS ARRANGED BY SUB AREA COMMANDER
9 FATHER MR Z BLOGGS, 999 KANGAROO STREET, KOOKITOWN, AUSTRALIA 9999
10 C OF E
11 REQUEST NEXT OF KIN BE INFORMED
12 REQUEST SUB AREA COMMANDER FORWARD PROGRESS REPORTS AFTER MEDIVAC EFFECTED
13 NOT APPLICABLE

One wonders if Their Lordships had a quiet chuckle when the WRNS took over HMS Impregnable as their depot in Devonport. Situated on the Tamar River the establishment was frequently passed by HM ships and it was inevitable that someone would take up the challenge. The honour fell to an aircraft carrier which on approaching the Wrenery one day made 'From HMS Indefatigable to HMS Impregnable Betcha'.

ANNUAL GENERAL MEETING 1977

The Annual General Meeting of the Australian Naval Institute will be held at 1930 on Friday, 28th October 1977 at R.S.L. National Headquarters, Constitution Avenue, Canberra.

All office Bearers and Councillors are elected at the Annual General Meeting. Only regular members may vote and hold office. Voting must be in person at the meeting and proxies are not allowed.

Nomination of candidates for election is to be in writing, signed by two members of the Institute and accompanied by the written consent of the candidate, which may be on the form of nomination and should reach the Secretary by 14th October, 1977.

The Office Bearers of the Institute are:

a. President
b. Senior Vice President
c. Junior Vice President
d. Secretary
e. Treasurer

The Council of the Institute consists of:

a. The Office Bearers
b. Ten regular members known as Ordinary Councillors.

The formal Notice of Meeting and Agenda, Nomination Form for election of Office Bearers and Councillors and a Memorandum of Annual Subscriptions due for the year 1st October 1977 to 30th September 1978 have been inserted in this edition of the Journal for members' convenience.

The Purchase of the American FFG-7 Frigate in the Context of Future Equipment Policy for The Royal Australian Navy

BY DEREK WOOLNER

This article was written in 1976 and may be slightly dated in some matters of detail.

On 18 February 1976 the Minister for Defence announced the Government's decision to continue the program to purchase two Oliver Hazard Perry Class Frigates from the United States. This ship is also known as the FFG-7, and was formerly referred to as the Patrol Frigate. The following day the Minister signed the Letter of Offer from the Government of the United States of America. Thus Australia has now been committed to the largest single purchase of defence equipment in her history.

At $A330m in January, 1976 prices the cost of the two Perry Class frigates exceeds that of the F-111 purchase by more than $A30m. This difference will increase markedly by the time both ships are delivered in 1982, since the contract allows for general cost increases in wages and materials to be charged against the project. The general level of inflation upon which the US Navy has based its program financial estimates is 11 per cent per annum from 1974 till the end of the first stage of the procurement plan in 1982.[1]

A GENERAL PERSPECTIVE ON DEFENCE EQUIPMENT POLICIES

The Perry Class Frigate program is therefore prominent among the purchases of equipment for the Australian Armed Forces over the next six years. It may well determine the type of force

THE AUTHOR

Derek Woolner finished a Bachelor of Arts Degree at Sydney University in 1967. Eighteen months later he joined the Defence, Science and Technology Group of the Legislative Research Service, one of the sections of the Commonwealth Parliamentary Library. During the period 1973 till 1975, he worked as Research Advisor to both A.L.P. Ministers for Defence. Subsequently he returned to his old position in the Legislative Research Service.

In the period of his involvement in defence matters, Mr Woolner's greatest interest has been with the various aspects of equipment procurement, and especially with the fiscal consequences or limitations which these involve. During his period with the Minister, Mr Woolner had some involvement with several equipment projects and accompanied the Minister to Washington at the time that the Memorandum of Agreement, outlining Australia's options to participate in the FFG-7 program, was signed.

In his present work, Mr Woolner's frequent contact with Parliamentarians necessarily leads to an interest in the interactions of political and military requirements on defence equipment programs, and the manner in which debate from one side or the other often fails to find common ground. It is, therefore, in the wider context of the development of policy frameworks for equipment procurement that Mr Woolner approaches issues involved in the development of naval forces.

that the Navy will have become by the end of the century. It may well limit, by the indirect influence of its claim on Defence finances, the opportunities for the development of other Services.

The selection of two of a particular design of naval vessel is not, by itself, a defence policy. However, because of the great costs of major items of defence equipment any major purchase must affect the implementation of national defence policy simply by restricting the ability to exercise other options. Ideally, all major purchases will be integrated by, and incorporated within, an overall policy which would secure the greatest effectiveness from the available funds. In such circumstances the decision to purchase two ships would not appear to be an isolated event, deserving special attention. Rather, it would appear as part of a continuous program, regularly evaluating types of equipment to remedy shortcomings in the nation's defence structure. In these ideal circumstances the objective of national defence policy would be seen as the development of the overall structure and the purchase of particular types of equipment would attract much less attention.

Considerations similar to these may well have played a role in the introduction of the Five Year Defence Program (FYDP) of the Department of Defence. This is basically a tool for allocating priorities between equipment programs against an estimate of the funds likely to be available in the succeeding five years. In this perspective the selection of major equipment can be seen as a choice between *types* of equipment, say destroyers and patrol aircraft, as distinct from the selection of one of a range of nearly identical destroyers. The cost of providing equipment for one of the three Services affects the ability of the other two to meet their objectives. Therefore, the selection of equipment must also be made in the context of the role, and the priority, to be given to each of the Services in maintaining national security. The justification for purchasing equipment for each Service must then be argued in terms of its comparative advantage to national defence as a whole and not simply by a desire to replace retiring equipment with new examples.

This paper will avoid the approach of discussing the comparative merits of similar types of warship, any of which could possibly fill a NSR (Naval Staff Requirement) for a destroyer to replace earlier vessels marked for retirement. Experience suggests that once the Staff have had a NSR accepted, even if only in the negative sense of not breaching the spirit of defence policy, there is often little variation between the range of "brand names" which are serious choices. For instance, if policy is interpreted to support the RAN's continued operation of destroyers, if it is assessed that these vessels require certain characteristics, and that finance, as usual, is a limiting factor, it is likely that each of the range of choices available will be similar in size, capability and costs.

The attempt to find a cheaper alternative with the same characteristics, or a more effective vessel for the same cost is usually a fruitless exercise, because, given the same criteria, the costs of modern defence technology are uniformly extreme. If the specification of the type of equipment continues to be governed by the same policy guidelines the results, in terms of the type of equipment and its capabilities, are likely to be the same. Only when the policy guiding selection is changed is there likely to be a change in the type of equipment, as distinct from the "brand-name", considered to be the most appropriate to meet the nation's defence requirements. Once a S.R. (Staff Requirement) has been formulated it is generally too late to change the basic type of equipment ordered for the Services, although it is not unusual for financial stringency to force modifications upon a project.

This resume is necessarily simplified as the thoroughness of the equipment selections procedures of the Australian Department of Defence should not be under-estimated. Simply because of their thoroughness, Parliamentarians and citizens are likely to have little success in disputing the Department's preference among "brand-name" competitors for an equipment requirement. However, both Parliamentarians and citizens have a legitimate right to query the choice of defence equipment. And it is in the area of the policy guidelines determining the selection of types of equipment that they can argue without being overwhelmed by the weight of technical expertise. The selection of defence equipment is more significantly changed by showing how particular defence capacities could be better achieved by alternative means, or why the governing defence policy should reflect a differing scale of priorities. These perspectives involve questions of the type of structure (and therefore equipment) that Australia's forces should have, and the objectives that these alternative structures should be intended to achieve.

Structure of this Paper

This paper will attempt to evaluate the Perry Class program in the light of these considerations and assess the effects that it will have on force structure. These include both the positive aspect of the new technological capabilities that the ship will bring to Australian naval defence, and the negative elements of the restrictions which their great cost will impose on developments in other areas of defence. Each aspect will be studied in turn in an attempt to assess what the consequences will be and what reaction will be necessary now that the decision has been made to proceed.

Throughout these sections,reference will be made to governing policies which should be used to formulate the role of the Perry Class frigates in the Australian defence structure and the requirements for the evaluation of future equipment programs. Public statements by two senior officials of the Department of Defence are outlined in the Section "Strategic Framework for Equipment Selection" to indicate the direction in which defence planning is now evolving. Using the criteria indicated by these statements, the last section of the paper places the need for destroyer forces in the perspective of other equipment programs which the Services might well desire.

IMPLICATIONS OF THE PERRY CLASS PROGRAM – COSTS

The signing of formal contracts for the Perry Class program and the Minister's related statement of 18 February give the public data which illustrate the great costs of modern defence equipment. The cost of the program to provide two Perry Class frigates for the RAN is $A330m, an increase of $A143m over the estimated cost of the project when it was first announced in April, 1974. This is the "total project cost", which includes the ships, helicopters, spares, test equipment, ammunition, and support facilities including both workshops and some accommodation. The cost of the two ships alone amounts to $A 195m. This compares with the $A50m cost of *HMAS Perth*, commissioned in July 1965[2] which is a vessel of greater displacement and, in some aspects is more heavily armed. Yet the Perry Class is one of the first warships designed with the control of both capital (purchase) and operational costs as a dominating requirement, to be pursued even at the expense of reducing the ship's performance. The fact that the unit cost of each vessel should be almost $100m, despite this control, indicates the extreme cost of modern defence equipment. This cost has several consequences for national policy.

Inflated Costs and Competition for Funds

Seen in one perspective, the total project cost of the Perry Class is 81.7% greater than the $181.6m allocated to the purchase of all capital equipment items in the Defence Budget for the 1975-76 financial year. In fact, the project cost is greater than the total spent on all capital equipment over the last two financial years ($283.9m) and is larger than the vote for all new equipment spent in any financial year during which Australian Forces were not engaged in fighting–recognizing that comparisons further back in time become somewhat pointless unless prices are discounted to compensate for inflation.

Of course, the cost of the Perry Class program will be spread over at least seven financial years at an average annual rate of approximately $47m. Nevertheless this still equals almost 26% of the funds spent on all equipment this financial year. In practice expenditure will not be in equal instalments and the financial burden will be greatest towards the end of the program, after the first Australian ship begins fabrication at the Todd Shipyard, Seattle, in 1978. At this stage, the burden of the Perry Class program can be

HMAS PERTH

–Defence Public Relations

expected to become an increasing problem for Departmental financial management. When he announced a planned increase in the real Defence Budget, the Minister for Defence stated that the significant increase would not occur till the last 3 years of the Five Year Program. Significantly, this will be about the time that the Perry Class begins fabrication.

It could be argued the growth of Commonwealth revenues in the intervening period, due to the increase in personal tax rates and general inflation, will allow the Commonwealth's expenditure and therefore the Defence Budget, to increase and thus avoid this problem. However, the terms of the agreement under which the two ships are being purchased allows the builder to charge any increases in wages or materials costs to the purchaser. Shipbuilding costs have, if anything, exceeded the rate of inflation indicated by the Consumer Price Index.[3] Indeed the cost of the Perry Class program has increased by 77% since the Government first announced its decision to purchase the vessels, less than two years ago, in April 1974. This is greatly in excess of the 11% per annum by which it had been assumed that costs would increase over the life of the program. Whether or not the rate of cost increase will slow and allow a long-term increase nearer to the planning assumptions is impossible to predict at this stage. In trying to assess the impact of the Perry Class program on the structure of Australia's defence finances, it is best to follow a cautious approach and assume that the proportional demand of the program on funds for new capital equipment will not change without a conscious decision to increase the real value of funds available for defence equipment.

The Perry Class program is only one, albeit the most expensive, of several defence equipment programs announced in the last two years. Few of these projects have as yet had a significant effect on Budgets, but their costs will become increasingly noticeable over the next few years. During the last two years the Government announced intentions to purchase equipment worth a total of $610m at costs then prevailing and which have since escalated to about $800m. Because of the time lag between the decision to purchase equipment and its delivery ("lead time"), payments for new equipment usually do not begin until some years after their announcement. Accommodating these payments within the Defence Vote becomes a problem for future Budgets. This is especially the case when re-equipment programs follow a period of relatively low purchasing or where the costs of a particularly expensive project can demand a disproportionate share of the funds normally available for new capital equipment. Table 1 attempts to give a diagrammatic summary of this process.

Of the commitments of the last two years only that for the 53 medium tanks will be discharged in the near future. Delivery of these weapons systems should begin in October and be completed by late 1977,[4] so that the Budget impact of their approximately $34m cost (at August 1974 price levels) should not extend over more than the next two financial years. However, the 1975-76 Budget decision to purchase a further 34 tanks will involve additional outlays towards the end of the decade.

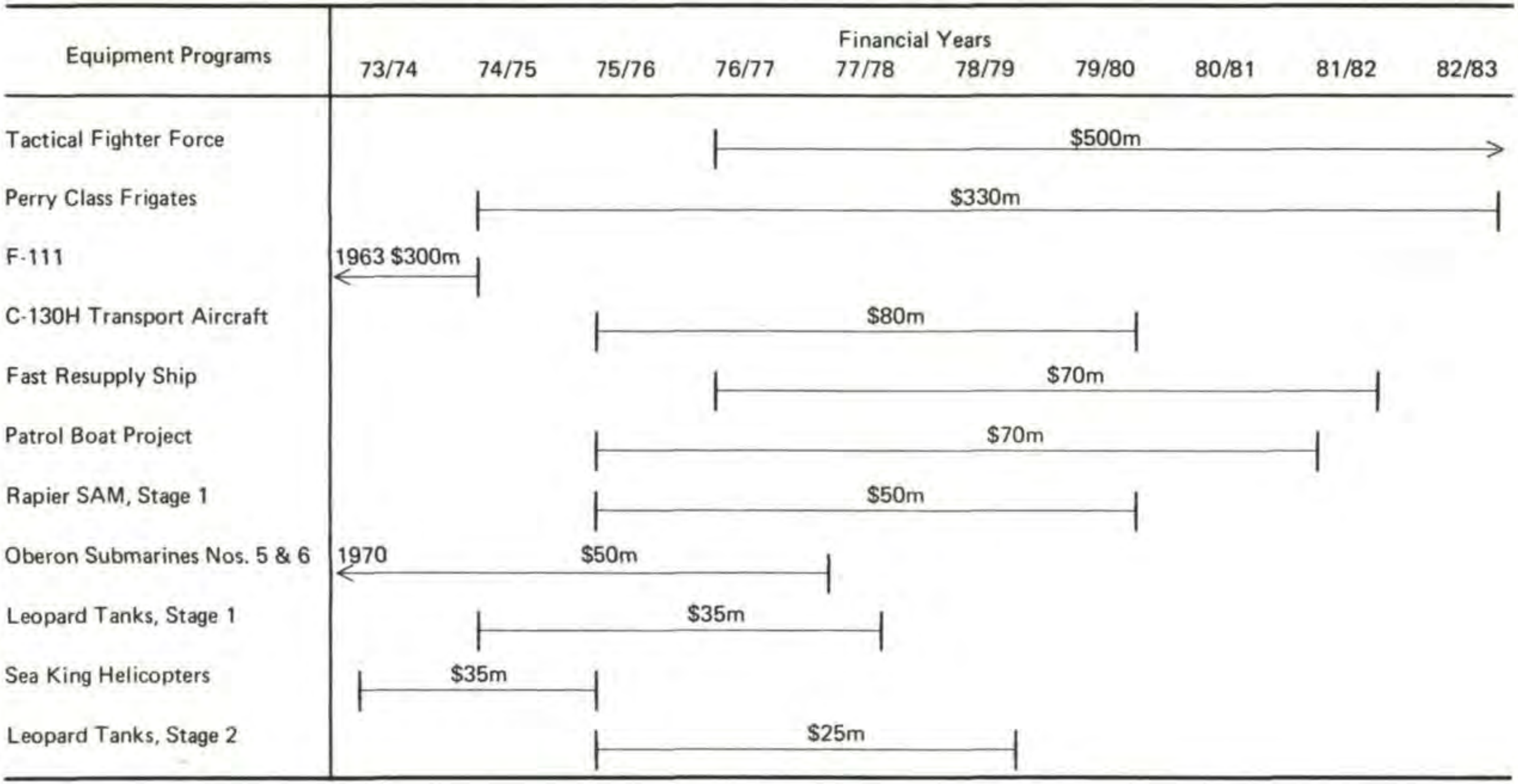
This process of organizing finance for equipment programs the payments for which are spread over different time scales, is integrated under the

A LEOPARD TANK SHOWS ITS PACES

—Defence Public Relations

TABLE 1

LIKELY MAJOR ITEMS IN FIVE YEAR PROGRAMS



The figures above each line in the chart represent an estimated cost for the entire project. This cost is financed out of the Defence Budget for each year during which it is in progress. The cost of the new equipment in each year's Budget is found, in principle, by adding together the average one year cost of each of the equipment projects which are in progress during that year.

FYDP of the Department of Defence. This process allows a degree of forward planning in the *allocation of finance* and, hopefully, prevents sudden fluctuations in the level of finance from year to year. The Government can announce a commitment to a certain equipment program for which no large payments are required over the years immediately following. At the same time, however, it has to continue payment for equipment which was approved some years before. The payment periods for two such programs, one new, one old, can easily overlap increasing the liability for finance in any one particular year. The Government can, theoretically, approve a range of equipment items in any one year with payments spread over such a time scale so that the annual liability is not greatly increased. However, if approvals for new equipment continue each year at a rate higher than the Budget appropriations for equipment approved in earlier years, Budget appropriations will eventually have to increase to the level of new commitments. It seems that the pressures to reconcile the Budgetary equipment vote with the cost of new approvals will be particularly great towards the end of the decade and this has prompted the Government to spent $12,000m in real terms on Defence over the next five financial years.

Several major projects will require their heaviest payment in the last years of the decade, at the time when, with the two frigates beginning fabrication, the burden of the Perry Class program should be increasing. The first of eight Long Range Patrol aircraft should enter squadron service late in 1978, and payments for them or their acoustic processors can be expected to be allocated beyond the 1979-80 Budget. This program was to cost $109m when it was approved but, by the time that the Lockheed P-3C had been selected as the LRMP aircraft, in May 1975, this had increased to $A150m. The battery of "Rapier", anti-aircraft missiles will also be entering service during 1978-79 and payments to meet this cost of approximately $A50m will peak slightly before this time. These are only a few of the programs which the Government has approved and which will each claim their share of the Defence Budget allocation for new capital equipment at some time during the period when funds will have to be allocated to the Perry Class program.

Moreover these projects which have already been approved, are not the only equipment purchases which could be making some demand on defence funds in the period till 1982-83. There are other items of equipment which ideally should be replaced around the turn of, or early in, the 1980s. Payments for these equipments would also be required during the period of the Perry Class program. For instance, the RAN's oiler, *HMAS Supply* will require replacement by 1980. This project was suspended in 1973 whilst alternative designs were studied in an attempt to reduce costs, which had grown from an estimated $42m to $69m. A decision to approve a replacement as part of the 1976-77 Budget has already been foreshadowed.[5] The successful tenders to develop a new class of patrol boat, worth approximately $A35m for the first order, have recently been announced. These boats will be delivered only slightly earlier than the Perry Class frigates. The new tactical fighter aircraft for the RAAF will need to enter service in the early 1980s and a decision to proceed with the project was to have been considered in the context of the 1976-77 Budget[6]. This project has been estimated to cost approximately $A500m at present monetary values.[7]

These and other equipment projects will all be making some claim, either nominal or substantial, on defence equipment funds during the period of the Perry Class program. Thus it can be seen that although the $A330m cost of the Perry Class program will be spread over several years, this annual average will be no less difficult to accommodate within the Defence Budget. The approval of defence equipment projects in two successive years with an average total value of $A400m implies that the annual appropriations for equipment must come to approximately that level shortly afterwards, if the impetus of re-equipment is to be maintained.

Such an increase could be avoided if new equipment projects in the coming years were reduced to a nominal level and the costs of equipment programs approved in the last two years were averaged-out over a longer time scale. As we have seen, this is an option which will be difficult for any Australian Government to exercise and which the Minister's recent statement in effect rejects. If this situation is to be avoided and equipment projects of a similar total value to those announced in the last two years are to be approved, expenditure for new capital equipment for the Services will have to rise to approximately $300 m, (this is without allowing for the effects of inflation). When it is considered that the $181.6m allocated for this purpose in the 1975-76 Budget is an increase of almost $80m over that of the previous year, and that the average expenditure within this category between 1970-71 and 1975-76 (unadjusted) is $120m some idea can be gained of the dimension of the problem.

The Effects of the Planned Budget Increases for Defence

Although the total Defence Budget has increased by 60.6% between 1970-71 and 1975-76, from $1091m to $1800.146 most of this has been absorbed by higher running costs, such as salaries and maintenance and, as has been shown above, the amount allocated for capital equipment has increased remarkably little, even when no allowance is made for inflation. Concomitantly the proportion of the Defence Budget devoted to new capital equipment as a percentage of the total, fell from12.7 in 1970-71 to 5.7 in 1974-75 and is estimated to rise to 9.7 in the 1975/76 financial year.

It can be expected that the Defence Budget will allocate a lesser proportion to recurrent "running costs" once the newly announced increases take place, than has been the case over the past several years. However, the major savings in civilian manpower resulting from the re-structuring of the five former Defence related departments have probably been realised,[8] and the Minister for Defence has announced an objective to increase the size of the Army by 2,500 to reach 34,000 in 1978 with an eventual growth by a further 4,000.[9] Manpower costs have been the most rapidly increasing area of the Defence Budget in recent years, [10] and at an average cost of $10, 000 per man, the first stage of this projected increase will cost $25m for each year from 1978. This is for manpower alone without considering the cost of other necessary expenses such as the training effort involved, housing, re-establishment payments, etc.

A closer inspection of the new guidelines for the Defence Budget, as given by the Minister in his statement of 25 May, reveals that tight pressures on the Defence Budget will continue to be felt. The following paragraphs are not intended to be a precisely accurate prediction of the future division of Defence funding. They are meant to be illustrative and give a "feel" for the extent of demands which National Defence makes upon the Budget. The total to be spent on Defence over the next Five Year Plan (the next 5 financial years) averages at an annual expenditure of $2,400 m in current costs. This implies that the value of the Defence Budget in 1980-81 will be increased to cover the extent of inflation over the next five years.

However, in dividing the $12,000m, or whatever its equivalent in real terms may be at the time, the Minister indicated that the annual allocation would not be simply averaged-out, but would be concentrated in the last three years of the Program. He affirmed that the Defence Budget this financial year would increase by $300m in real terms over the allocation of 1975-76. On this assertion one can conclude that, in broad terms, the Defence Budget for the financial years 1978-79, 1979-80 and 1980-81 will be $2530m in May 1976 dollars.

In attempting a more detailed analysis of the future allocation of finance for Defence, the significant part of the statement was the Minister's indication that the reason for greater planned expenditure over the latter three years was the impracticability of increasing expenditure on new equipment within the short span of two years.[11] This is consistent with what is known about the planned Defence equipment program from statements of both the current and former Ministers. The 3 year period from the 1978-79 financial year falls within the busiest phase of the building program for the Perry Class and several other expensive equipment projects, such as the fighter force and the Fast Underway Replenishment ship.

The Minister's speech implied that most of the $300m increase planned for 1976-77 would be absorbed by recurrent expenses and development of facilities.[12] Mr. Killen promised an immediate increase in service activity, especially training and exercises, and stated the Government's intention to continue works programs such as *HMAS Stirling* and the redevelopment of naval dockyards. These are commitments that are likely to continue into the last three years of the Program. For instance, once *HMAS Stirling* is commissioned in 1978, work will have to continue on the large-ships' wharf, the armaments depot, and the explosives jetty, if the Government's objective of developing the Cockburn Sound facility into a naval base are to be realized. Similarly, the rehabilitation of the "Oil" and "Cruiser" wharves at Garden Island, Sydney, might logically be followed by the long-planned development of the Eastern shore of the dockyard, if its complete rehabilitation is to be achieved.

One can fairly conclude, from the Minister's statement about the time-scale for delivery of new equipment, and from a consideration of the extent of other expenditures (such as manpower costs, recurrent expenditure, and development of facilities) that the amount which will be available to purchase new equipment will be the difference between the immediate increase in the Defence Program, and the five year average increase. Thus, in very broad terms, one might assume that the increase in the Defence Budget which will be available to purchase new equipment will be something of the order of $330m. To this should be added the $181m allocated for the purchase of new equipment in the 1975-76 Budget. This gives a broad idea of the amount available for the purchase of equipment, in real money terms, during the last three years of the Program. Again, it should be stressed that this is only a very rough estimate, which cannot hope to be precise. However, it should be useful in illustrating the fact that even following the planned increases in expenditure revealed during May, the problems of financing equipment programs for the Services are not suddenly dispelled.

AN F-111 ABOUT TO TOUCH DOWN

—Defence Public Relations

A brief resume of the cost of some of the proposed equipment programs, and a rough estimate of their effects upon the equipment Vote in the three year period, will illustrate this. The most expensive program during the period will undoubtedly be that for the tactical fighter. At an estimated cost of $500m for all aspects of this project, the tactical fighter could be expected to cost something like $100m for each of these three years. As already noted, the Perry Class program will cost something around $50m in the same period. According to Press reports of 17 June, the Patrol Boat program may be extended to 10 boats, to be delivered by about 1981. On previous indications of their cost, the Patrol Boat program could add $30m to equipment costs in the last two financial years of the program. One could anticipate a similar amount due in the third year to pay for the last of the C-130H "Hercules" transport aircraft which enter service during that period. If *HMAS Supply* is to be replaced when it retires in 1980 or 1981, the Fast Underway Replenishment Ship will have to be built over the last three years of the Program. It is fair to expect it to cost $60-70m, thus adding at least a further $20m to the equipment Vote for each of those years.

Other projects have already been scheduled for the period of the Five Year Program and allowance should be made for the effects of their costs on the equipment vote for the last three years. These include the Heavy Lift Ship, announced in the last Budget, and then costed at about $45m. The development of a reconnaissance role for the F-111 has been under study for some time and at least a proportion of its $30m cost will be paid during that period. Amongst some of the major projects which have been under study by the Department and Services, and which could be expected to proceed during the period under discussion, are the second stage of the Rapier anti-aircraft missile project and the purchasing of Harpoon surface-skimming missiles for the Perry Class frigates, the P3-C "Orion" aircraft, and probably for the RAN's submarines. The Army is involved in an evaluation program of both medium and field artillery, and replacements for its present 5.5" and 105mm guns will be needed around the turn of the decade. The RAAF's Caribou, HS748, and the venerable Dakota aircraft will be due for retirement from 1980 on and the RAAF has had a team engaged in a "Short Range Transport" study for the last year. It should also be noted that the Navy has a severe problem with the imminent obsolescence of its Mine Counter Measures force (see page 36) and still has no definite plans to introduce missile-armed FPBs although the nature of an

RAN force based on destroyers and advanced missile-armed patrol boats is being studied.

The point of this recitation of known and likely commitments to purchase equipment is simply to illustrate the fact that the nation cannot afford to be any less critical in choice of defence equipment projects than it has been in the past. One of the greatest problems of national security is its cost. This is not a problem simply because it is difficult to finance, but because it can often produce a distorted perspective. The Government's decision to increase the Defence Budget may well relieve some problems towards the end of the decade. It may even permit a greater flexibility and some room for experimentation that was not present before. However, one can be sure that there are still important areas of military technology which Australia will not be able to acquire even after the planned increase in the Defence Budget has taken effect. The implication is that, in considering the most appropriate equipment policy for the RAN in the light of the Perry Class program, one should be no less discerning because the amount of finance available to purchase equipment has been increased. At an average cost for the ships themselves of almost $100m any decision concerning future purchases of destroyer-type vessels remains a policy which continues to warrant the closest scrutiny.

The increased cost of the Perry Class frigates undeniably compounds the difficulty of fulfilling current and likely future programs. However, as the RAN would like the present Perry Class program to be only the first of several, the total costs of Perry Class frigates could involve the long term diversion of a considerable proportion of all funds presently available for all types of new equipment onto a single type of equipment. Consequently, funds for other areas of naval warfare, for the other Services, and for the development of Austalian defence industry would be restricted, if the finance for equipment is not increased in real terms.

Modern frigates are versatile ships and can perform many roles, but they cannot by themselves provide the range of technological and operational experience which the nation's defence requires from a modern navy. The cost implications of the Perry Class program and the RAN's desire to build additional Perry Class ships are that the force structure of the Navy may become concentrated around the operation and support of a small number of technically sophisticated, versatile but expensive vessels. These vessels would effectively absorb the funds available for naval equipment leaving the RAN with only a token force to maintain its familiarity with some areas of naval warfare, and forcing it to withdraw from other areas altogther.

In the political sense, probably the most challenging implication of these budgetary problems is that it encourages the Government to review the traditional equipment policies of the Services and investigate more economical force structures and equipment requirements.

IMPLICATIONS OF THE PERRY CLASS PROGRAM – RAN FORCE STRUCTURE

Throughout the 10 year search of the RAN for a new class of destroyer-type equipment its thinking has been influenced by its existing force-structure. Although it initially hoped to develop a small, cheap vessel, inspired by experience of, and requirements revealed by, its involvement in "Confrontation" between Indonesia and Malaysia, "with the passage of time, it became clear that any new destroyers could no longer be in addition to the existing force but would be required to replace aging destroyers".[13] If nothing else this indirectly admits the strong role which finances have played in distorting the ideal equipment programs of the RAN. It is unlikely that the cost of the Perry Class program will be any less powerful in forcing the RAN to recast its equipment objectives.

However, at the moment the main preoccupation of the RAN is to prevent any quantitative decline in the strength of its destroyer force. In 1972 the project to develop an Australian designed destroyer (the DDL) was justified by the then Deputy Chief of Naval Staff on the basis of maintaining the RAN's strength of 11 destroyers throughout the 1980 s. A requirement to maintain this strength till the end of the century was advanced as the justification for a "further acquisition program of some sort".[14]

Some three years later the RAN is still thinking in terms of preserving its existing Force Structure and deriving its priorities for equipment programs from the need to maintain the status quo. Although the object of its studies is a different "brand name" it is essentially the same type of equipment as the earlier DDL. Thus the policy justification for the Perry Class program can be expressed in almost the same words as were earlier addressed to the DDL. "The RAN has at present 11 destroyers: 2 Daring Class, 3 DDGs, 6 DEs. Their average age is 12 years and they all reach the end of their lives by the early 1990s. Their replacement is becoming urgent and the two FFGs are the first ships in *what must be an ongoing program*"[15] (emphasis added).

The procurement strategy indicated here is a direct successor to the thinking which has dominated the RAN's 10 year search for new destroyer type vessels. This thinking led initially from the concept of comparatively cheap solutions, to the complex, versatile but expensive DDL project. In 1974, in an attempt to lower the direct costs and developmental risks of the DDL project, the Government, in effect, changed the "brand name" of the destroyer replacement, by cancelling the DDL and initiating the Perry Class project. Yet, basically, the RAN's destroyer replacement program has remained the same for the past 10 years and the urgency of the need to proceed with the Perry Class program enunciated above, is not unlike that of Rear Admiral Synott, urging the need to proceed with the DDL project, some three and a half years earlier: "It can be seen that any serious delay in providing new destroyers could leave us with a very reduced number of obsolescent ships; and a further acquisition program of some sort will be necessary just to replace the capability of ships phasing out in the late 1980's.[16]

The significance of this similarity in equipment philosophies is that it betrays no reaction to the details of cost revealed in the Minister's approval for the program. The implications of the program's costs are significant because the Perry Class was to be a cheaper means for the RAN to implement its destroyer replacement policy. The component parts of that cost are significant because they provide cogent reasons for the RAN's apparent decision to concentrate on the Perry Class as its standard destroyer type vessel. This decision in turn has implications for the local naval ship building industry.

If it was to be the "cheap" option, the Perry Class program can no longer be considered as such. Yet it is unlikely that a vessel with similar capabilities could be acquired any more cheaply. The Perry Class was conceived at a time when several other American weapons systems had literally priced themselves out of existence. Concern over the high number of defence contracts which significantly exceeded the initial cost estimates led to Congressional caution in developing new equipment programs. The Perry Class represented part of the answer of the then Chief of the USN, Admiral Elmo Zumwalt to this diffidence. Zumwalt championed a concept of a "high-low mix" wherein only those items of equipment whose operational role demanded it were built to the highest levels of operational capabilities and weapons technology. All other equipment was designed around very much more tightly controlled operational concepts to result in the cheapest possible vessels to perform the role. Zumwalt argued that the development of new weapons systems was in danger of being strangled by their own costs. To avoid this, features of the design which, while useful, were not essential but which, because of their cost or likely developmental difficulties could threaten the entire viability of the project, would have to be removed. The Perry Class was one of several of Admiral Zumwalt's projects which were designed to do a specific job at the least possible cost.

Throughout its developmental history the Perry Class has been under tight Congressional control and has had to pass a series of reviews known as DSARC (Defense Systems Acquisision Review Committee) before approval for the next stage of the project could be granted. The design was developed with cost saving as a predominant requirement – hence the ship's single shaft propulsion system. This approach is dramatically opposed to earlier practice. Traditionally defence equipment has been designed with the primary objective of meeting specifications, with costs treated as an ancillary variable. As yet no other ship of its type has been developed under the "design-to-cost" philosophy and it is unlikely that any other vessel could provide the same capabilities, within the same time scale, for a lower cost.

The high cost of the Perry Class program, when viewed in this light, has even more serious implications for the RAN. It means that the Navy's program to maintain its destroyer force at its present level has become an extremely expensive ambition, irrespective of the "brand name" of destroyer it chooses. Officially, the RAN has not acknowledged this fact and according to its public statements is still planning to maintain its eleven ship destroyer fleet.[17] If it continues with this policy there are several reasons why the Perry Class will most likely form the basis of that fleet.

Standardizing equipment on the Perry Class will result in considerable savings. It will enable the reduction of inventories of spares and ancillary equipment with resultant cost savings. Training and other technical aspects of maintenance will be simplified. More detailed knowledge of operational requirements and more accurate forecasting of maintenance requirements gained through knowledge of earlier ships of the class can be used to develop more economic methods of operating later ships. These can be modified, if necessary, to overcome any problems, or provide any improvement indicated by experience gained with earlier ships of the class.

These advantages are not cheaply gained however, as the cost for the two ships alone is $A195 m whilst the cost of the "infrastructure" necessary for the RAN to bring them into, and maintain them in, operational service is $A135m. Of this some $A25m is required for the helicopters and their equipment. The remaining $A110m can be considered as an investment in the future support of its two new frigates. It is simple economic sense to extract as much value from such an investment as possible. This can be done by increasing the utilization of facilities with the workload provided by buying additional Perry Class Frigates. Conversely, the total project cost of subsequent Perry Class programs can be reduced by using the infrastructure, established with the purchase of the first two ships. This implies however, that the RAN's freedom to choose a new class of vessel for future programs will be severely restricted by the cost of establishing support for each new class of ship.

This said, it is unlikely that the Perry Class frigate will be chosen to replace *all* of the RAN's current destroyer force. The type may not be in production long enough to replace destroyers retiring in the 1990s. Since the vessel's design dates from 1970, it will be obsolescent even if still available by then. However, four of the RAN's destroyers are due to retire towards the end of the next decade, at the latest,[18] and it may be, that the RAN will propose one further Perry Class program of up to four ships, to replace these vessels.

A Qualitative Expansion of the Destroyer Fleet

Whilst the procurement of additional Perry Class frigates to replace retiring destroyers will allow a more efficient use of defence resources it would involve a subtle but important change in the force structure of the RAN. In quantitative terms, the Navy's desire to replace each of their retiring destroyers in turn, represents only the maintenance of the status quo. Qualitatively, however, a replacement program based on the Perry Class frigate will give the RAN a destroyer force of much greater power than it now possesses. This is the ultimate reason for, and justification of the great cost of the program and the outlay on this vessel is bringing several important new capabilities to the RAN. This factor reinforces the trends which the financial aspects of the program have created. For, since the cost of the Perry Class program seems likely to concentrate more of the RAN's financial resources on its destroyer force, so the new capabilities it is gaining with these frigates will concentrate more of the RAN's technological expertise and operational strength on this force. The interaction of these factors means that in the next decade the RAN's strength will become more concentrated around a force of eleven ships.

By replacing the two Daring Class Destroyers with the Perry Class, the RAN will be substituting a vessel designed around missile technology and its own air support unit, in the place of a vessel armed with the traditional destroyer weapons of six medium-calibre guns. Should the Perry Class also replace the four ships due to be retired in the second half of the 1980s, the qualitative improvement will be even more marked. These four ships are River Class Destroyer Escorts (DE) which are much smaller and less capable ships than the Perry Class frigate. They displace only 2,700 tons compared with the 3,500 of the Perry Class ships. They are primarily anti-submarine escort vessels whilst the Perry Class have a more

HMAS VAMPIRE (Daring Class)
—Defence Public Relations

general purpose role. In their own ASW role the DEs are efficient ships but with only a twin 4.5 inch gun mounting and a short range "Seacat" point defence anti-aircraft missile system, they lack the equipment to perform the roles of which the Perry Class is capable.

Should the Navy proceed to replace much of its destroyer fleet with the Perry Class, it will have transformed the structure of that force by the end of the next decade. From a fleet of 11 vessels, none of which can operate helicopters and only 3 of which possess an anti-aircraft missile system capable of defending a large area from aircraft attack, the Navy will have six destroyers capable of operating their own helicopter support. All but two of them will possess an area defence anti-aircraft sytem. From a fleet, over half of which now has a displacement of less than 2,700 tons, it will have a fleet where its largest class of vessel displaces 3,500 tons.

The operational capabilities of modern warships depend on more than the obvious elements of the weapons system which they carry. Because of the increased capacity of modern fire control systems, ship mechanical design and ship maintenance programmes, around which the Perry Class has been designed, the RAN will have a destroyer fleet of even greater potential than would appear to be the case at first sight. The speed with which an engagement between modern weapons systems can develop, makes severe demands on command and control systems and it can be said that the command systems which now equip the RAN destroyer force are a greater handicap than are any shortcomings of the weapons which they carry. The modern Naval Combat Data System (NCDS) with which *HMAS Perth* has recently been fitted, is closely related to the system to be installed in the Perry Class frigate. An NCDS, which automatically collates and analyses target data and provides command information for the ship's weapons system is essential for survival in present-day naval warfare. The qualitative improvement that this represents can be fairly described as the difference between being able to engage an attacker, or being destroyed. As such the improvement this will bestow on the RAN's destroyer fleet in incalculable.

Similarly, the efficiency of the destroyer fleet will be improved by the reduction of crew numbers. The Perry Class operates with a total of 185 crew compared with the 320 of the Daring Class which it will initially replace, and the 333 crew men required by the DDG. Finally, the maintenance philosophy designed into the ship is that major components should be removed, and repaired on shore whilst an exchange unit is used by the vessel. Thus the Perry Class will be in dockyards for about half the time required by a DDG for normal refits,[19] and will have an availability rating of about 90% compared with the average presently attained by destroyers, of about 70%.

Considered in total, these factors indicate that the RAN's destroyer force, if re-built on the basis of the Perry Class will be a far more effective, efficient and potent fleet by the end of the 1980s than it is at the moment. Yet, as stressed above, it will be an increased performance bought at considerable price and with the implication of either diverting funds from other national purposes or of concentrating the Navy's strength almost exclusively around its destroyer fleet. Furthermore, although the capabilities of ships will have increased markedly so will that of the threats which they must face and counter to survive. The implication of the "threat environment" on the future usefulness of the Perry Class will be discussed in the section on the technological implications of the program.

IMPLICATIONS OF THE PERRY CLASS PROGRAM—THE LOCAL SHIPBUILDING INDUSTRY

The two Perry Class frigates will be built in a United States shipyard. There is no reason to believe that any ships of the same class which might be purchased for the RAN would not also be built in the United States.

The Perry Class has been designed to take full advantage of the concept of modular ship building. This process can be roughly described as the application of production line techniques to shipbuilding, and results in similar improvements in efficiency. However, the advantages of modular construction can only be achieved where production is large enough to absorb the cost of purchasing equipment and reorganizing the slipway. This is the case with the US Navy's Perry Class program which is planned to eventually produce 69 vessels.[20] The RAN can share these economies of scale only by joining the US Navy's program and having their ships built as part of the USN production run. These savings are considerable if only because two ships would scarcely be enough for an Australian construction yard to become familiar with the design, let alone to provide a sufficient base to amortise the capital investment costs. Production of the RAN's Perry Class frigates in the United States also reduces the technological risks since the contractor is familiar with the task and has solved his construction problems on earlier US Navy ships. It is unlikely that comparative economies of scale could be achieved in an Australian yard even if the four ships retiring in the late 1980s were to be replaced by Perry Class frigates built in the same Australian yard.[21] Furthermore, there are advantages for a Navy in having its vessels constructed in the same yard. Despite any apparent similarity of blueprints, naval vessels constructed in different yards always seem to have subtle but important differences in specifications These changes might result from a slight repositioning of a pump or winch or from a change of ancillary equipment where a yard has been slow to order and has been forced to accept a substitute. Such apparently unimportant differences can greatly complicate ship maintenance, upset time schedules and reduce the availability of the ship for operations with the fleet. The chances of such problems occurring with ships constructed in the same yard are less likely than is otherwise the case. Significantly, the Government specified in the Memorandum of Agreements which covers the purchase of the two ships[22], that both RAN vessels should be built as part of the same production run in the same US shipyard.

If the Navy were to continue its replacement of destroyer type vessels and take the step of ordering another Perry Class program, it is likely that these vessels would be constructed in the US. If this is the case, the decision to purchase the two Perry Class frigates has effectively ended the construction of warships of the destroyer-type in Australia during peace time. The last ship of this type constructed in Australia, the "River" Class DE *HMAS Torrens* was commissioned in 1971. A gap of almost two decades would occur between the construction of this ship and the next possible construction project, the replacement of the four DEs due to be retired at the end of the

HMAS TORRENS —Defence Public Relations

1980 s. This is too long a period for the industry to maintain its skills. Its economics can only become less competitive over time.

In the future, the role of the Australian naval shipbuilding industry in peacetime appears to be the construction of non-combatant vessels such as the proposed AOE (a fast supply ship) or the Heavy Logistics Ship, or types of escort vessels smaller than conventional destroyers and frigates. Apart from these the only possible program would be construction of either specialist vessels, such as minesweepers and mine-hunters, or medium-sized patrol boats. Many of these projects might "make work" for the naval dockyards but would still be unsuitable for them. The non-combatant and other vessels, may well be produced more cheaply in commercial yards. These dilemmas will have to be assessed by policy when determining the future development of the nation's defence structure.

However, the decision to purchase the Perry Class frigates in the United States will not create problems for the naval dockyards in the immediate future. The modernization of the two DDGs at Garden Island and three of the RAN's DEs at Williamstown will introduce both naval dockyards to important new technologies when these programs begin later this year. The RAN's scientific vessel, *HMAS Cook* is under construction at Williamstown and parts of that yard are involved in a redevelopment program. Indeed, were a destroyer construction program added to the workload at Williamstown it would have been necessary to re-schedule much of the DE modernisation program to other yards and at the same time, increase the labour force at Williamstown by about 25%.[28] It appears that the current workload at Williamstown and the difficulties created by the re-development program would have made it difficult to start a new destroyer construction program before 1980,[24] had the Government decided to build the frigates in Australia.

In the long term, however, the situation for Williamstown is somewhat anomalous. Since 1973 Williamstown has been progressively re-developed to employ modular construction techniques and complex systems integration tasks. Already $7.5 m has been budgeted for Stage 1 of the reconstruction program and further money was budgeted for it in the Current Budget. Funds already spent have been for the establishment of the modular construction facilities whilst the provision of new electronics workshops was to start with 1975-76 Budget funding. Even though these latter facilities can be employed in modernisation programs, such as that for the DEs, the future of the building yard appears less certain. The slipway at Williamstown is restricted and vessels of more than about 420 feet overall length and designed for full-load displacement of around 4,500 tons cannot be built there. Fleet auxiliary, vessels are simply too large to be built at Williamstown. For instance, a typical fast combat support ship is of more than 500 feet in length and designed for a full-load displacement of somewhere between 16,000 and 20,000 tons.[25] On the other hand, the fabrication hall at Williamstown has been designed to handle modules weighing several hundred tons and both it, and the slipway auxiliary equipment, would be under-utilized by a patrol boat program. Similarly, as a yard designed to work in steel and aluminium, Williamstown would have some difficulty in producing specialist vessels such as mine counter measures craft as the most modern of these vessels are constructed from Glass Reinforced Plastic.

Thus the decision to purchase the Perry Class frigate from the United States yard leads to the anomalous situation of the Government rebuilding a naval shipyard to produce modern warships efficiently but having no project to utilise these improved capabilities adequately. Neither the last vessel produced at Williamstown, the survey ship *HMAS Flinders* nor its present task *HMAS Cook*, are of the level of complexity found in warship construction and neither provides work to justify the extensive investment in the modernisation of the yard. In effect, the Government is now funding a project for which no long term use has been devised.

It should be noted that the involvement of local shipyards in building modern warships was not very deep. For instance, it was estimated that little more than 10% of the DDL project would have been attributable to local labour costs. The only addition was the value of fabrication and basic raw materials, such as sheet steel. Most of the systems in any program to build modern warships would be imported and the greatest task of the local builder would be to integrate these into a working entity within the hull of his ship. This is a complex and difficult task in itself, and one in which the Australian industry is still not well versed, but it is not one which approaches, in monetary terms, the value of the imported equipment. There is no local industry able to manufacture the marine gas turbines now used to propel naval vessels. The premium involved in building warships in Australia is a severe qualification of the usefulness of development schemes such as that for Williamstown. Its supporters would probably argue, however, that the current weaknesses of the industry were the best justifications of redevelopment.

IMPLICATIONS OF THE PERRY CLASS PROGRAM – WEAPONS TECHNOLOGY

The Perry Class frigates will introduce the RAN to two areas of weapons technology of which it has no previous experience and will extend its abilities in a third area. These systems are surface-to-surface missiles (SSM), the use of helicopters from ships other than aircraft carriers, and area defence surface-to-air missiles (SAM). If it can be perfected, the Perry Class frigates will also introduce the Close In Weapons System (CIWS).

The RAN has no equipment capable of launching SSM s. These weapons are a significant advance because they allow small, lightly equipped vessels to seriously threaten larger warships which are not adequately protected. Because "surface skimmer" SSM s approach their target at very low level and high subsonic speed[26] and automatically and autonomously "home" on their target, they are extremely difficult to detect, destroy or avoid. Their absence from the RAN's inventory has been a significant weakness which will be remedied by the purchase of the Perry Class.

These ships are fitted with a dual-purpose missile launcher, the GMLS Mark 13 Mod. 4, which is capable of firing the US Navy's Harpoon SSM, a weapon with a range in excess of 60 miles. The launcher and magazine of the GMLS 13 system was originally designed to operate the Standard SAM but for use in the Perry Class frigate they have been modified to operate any combination of Standard and Harpoon missiles. No official decision to purchase the Harpoon has been announced but such an intention has been implied.[27] As the frigates will not be in RAN service till 1982 the purchase of SSM s could be delayed for some time, but the system may well be in service before the Perry Class reach Australia. The Harpoon is being developed in air, surface and sub-surface (from submerged submarines) launched versions and air-launched versions may be purchased for use from the RAAF P3C Orions which enter service in 1978.

The second area of new technology which the Perry Class will introduce to RAN service is the operation of helicopters from medium-sized warships. This is an operational procedure which has developed considerably over the last two decades but one which the RAN has not pursued until now. The ability to operate helicopters adds greatly to the versatility and fire power of a destroyer-sized vessel. Depending on their type, and the equipment provided, the helicopters can be used for surface surveillance or ASW detection, attack of land, sea-surface and sub-surface targets, communications duties or the transport of personnel and equipment to and from the ship. With modern communications systems the helicopter can transmit data from its own sensors directly to the NCDS of the parent ship and can in turn accept data from the ship, without the need for human participation in either case. The helicopter thus becomes a true extension of the ship's weapons system. When equipped with adequate surveillance devices and armed with appropriate missiles, helicopters offer the best defence against missile firing patrol boats as they can intercept and destroy the boats ouside the range of their SSM s.

The Perry Class is suitably equipped to make best use of its helicopters. The Perry Class design was altered at an early stage to include space and facilities for the operation of two helicopters rather than the one which had been envisaged originally. The cost that this involved was calculated to be offset by the increased effectiveness of the helicopter detachment, a significant estimation in the case of a ship as rigidly controlled as the Perry Class. Helicopters are notoriously temperamental and require far more maintenance than do fixed wing aircraft. On average a helicopter can be expected to be available only between 30 and 40 percent of that time. The ability to operate two helicopters therefore significantly increases a ship's capabilities. The frigates appear to be adequately equipped, with landing approach aids, maintenance facilities and storage for weapons, equipment and helicopter fuel.[28]

The RAN has already accumulated a great deal of experience with area defence anti-aircraft systems aboard its 3 DDG's of the Charles F Adams Class. To date these have operated with the "Tartar" SAM system but part of the modernisation program for these ships will convert them to the "Standard" SAM system. This is the same system used by the Perry Class frigates, although the launcher and magazine systems of the Perry Class have been modified to operate the Harpoon SSM also. The "Standard" has a longer range, better acceleration and responds to commands faster than the missile it will succeed.

After the Perry Class frigates enter service, almost half the RAN's destroyer fleet will be capable of offering area anti-aircraft defence to naval task forces or any similar, moderately sized convoy. The advantage of an area anti-aircraft system is that it enables a vessel to engage aircraft which are not necessarily approaching the ship, and allows them to offer protection to other vessels (thus protecting the "area" against aircraft attack). The anti-aircraft systems on the RAN's other escorts are primarily intended for self-protection and are thus referred to as "point-defence" systems.

The CIWS is perhaps the most important of the new areas of weapons technology which the Perry Class design will introduce to RAN service as it offers some hope of defence against sea-skimmer SSMs. The significance of SSMs derives as much from their comparative invulnerability to conventional shipboard weapons as it does from

AN FFG-7 OPERATING HELICOPTERS (Artist's Impression)

—Defence Public Relations

their deployment on fast patrol boats. Approaching at a height of only a few metres above the wave tops SSMs cross the ship's radar horizon at close range and thus give little warning. Furthermore, their detection is complicated by "clutter" – a type of "snow" on the radar screen created by returning echoes from the wave tops which often obscure the echo returning from the SSM. The speed with which SSMs approach (generally about Mach 0.95) gives ships little time to engage them, and if as is likely to be the case these missiles are fired in salvoes they may well "swamp" a ship's defence systems. The "single shot probability" of the CIWS destroying its target is 0.75, and with only a single installation, protection against multiple attack must fall correspondingly.

If destroyer-sized vessels are to survive in the next decade an answer to this threat must be developed. Several nations are developing CIWS for this task, but as yet none have been perfected. The US Navy's system is known as "Phalanx" and although the US Department of Defence asked for production funds in the FY76 Budget, Congress has refused to authorise production until all developmental problems have been overcome. Theoretically the RAN is not committed to a specific CIWS as the Perry Class program includes only "provision for fitting *at a later stage* of a Close In Weapons System for point-defence against aircraft or missiles"[29] However it is unlikely that another system would be fitted if Phalanx is successfully developed. On present costings addition of a CIWS to each ship will add $US7m to the program.

The Phalanx system is an autonomous, automatic system programmed to react without human command. It consists of a 20mm cannon surmounted by a pulpit containing the system's self-contained radar, computer and command and control system. The "doppler" radar is able to distinguish the missile from "clutter" and automatically trains and fires the cannon. The projectile is made of depleted uranium, a metal which has no radioactive properties and a density 1.5 times that of lead. For the same volume, the Phalanx will strike the missile with greater kinetic energy than a standard projectile, and will penetrate to the missile's warhead, causing the missile to destroy itself. The need to score a direct hit requires the system to compensate for errors with extreme rapidity and the system is designed to react without command. This is the cause of most of the system's developmental difficulties, as it has "triggered" itself against false alarms and friendly targets during trials.

Should these difficulties be overcome, Phalanx will give the Perry Class frigates some degree of protection against the threat of surface skimmer SSMs which it would otherwise lack. Conventional gun and missile systems are of little use against surface skimming SSMs unless it is possible to destroy the attacker with them before the SSMs are launched. The track and control radar of the Standard SAM cannot operate at wavetop height. Conventional medium calibre gun systems suffer from the same problem of "clutter" on control radars and when optically directed their rate of fire is insufficient to compensate for their inherent inaccuracy. As well, the random effects of pressure generated by the wave-tops would seriously affect the performance of proximity fuses. The deployment of a CIWS by the RAN is therefore of great significance if the destroyer fleet is to remain effective in the 1980's.

However one should be careful not to overestimate the role of technology alone in the maritime defence of Australia. Technology has its limitations even if not challenged by an enemy using a superior level of technology. The effectiveness of the Perry Class should be judged within the context of their systems. An important limitation is the capacity of the Mark 92 fire control system which directs the ship's Standard SAM system and the 76mm gun. This system has only two fire control channels and cannot engage more than two targets simultaneously. The ship would be endangered by concerted attack, especially if operating alone. For instance, a co-ordinated simultaneous, low-level attack from the four points of the compass would exceed the capacity of the Mark 92 system. The ship therefore, would be at risk where attack by a number of aircraft is likely. With only a single CIWS the ship would have difficulty in surviving co-ordinated attack by SSMs.

If in danger of such attacks the frigates would most likely withdraw, hoping, in the case of SSM attack, that its helicopters could harass and slow the faster patrol boats. This assumes that the frigates would receive adequate warning of impending danger from its two helicopters. However, two helicopters are not enough to guarantee detection of impending surface attack, or even the availability of one helicopter to counter-attack. Not only do helicopters have low rates of availability but surveillance systems onboard a single helicopter cannot give coverage out to the ranges of which SSMs are now capable. Some idea of the number of helicopters which this task requires can be gained from the specifications of the US Sea Control ship. This was intended to be the smallest, most economical vessel capable of providing adequate surveillance and response to low-level threats. The US Navy's conclusion was that 14 helicopters would have to be carried to provide enough for operations and that it would require a ship displacing around 14,000 tons full load from which to operate them. In some circumstances, therefore, the technology incorporated in the design of the Perry Class, whilst a significant advance in its own terms, is still insufficient to allow the ship to protect itself, let alone provide protection for other less capable vessels.

Furthermore whilst access to modern technology is important for the future development of the RAN, the cost of acquiring that technology becomes in itself a severe limitation on the use that can be made of it. Future Governments will have to consider carefully whether the risks involved prevent the deployment of equipment which represents a capital value of almost $100m. Again, dependence on technology has increased the vulnerability of defence equipment in some ways. The use of automation to reduce crew numbers, and the need for electronic data processing to cope with the rapid pace of developments in modern naval warfare, means that even minor damage can cripple a ship and render it helpless. An air burst from a near miss, which could destroy electronic-system antennas, could well render the ship "blind".

In many circumstances even the best of modern technology is inadequate and the concept of one ship, endowed with every modern weapons system, single-handedly warding off swarms of less sophisticated enemy units in the distant north is, at best, mythology. Effective action, if it is ever required, will continue to demand the same *balance of forces* that it has in the past. To maintain the ability to mount co-ordinated military action, the services will each need equipment which, while they are complementary in operation, are competitive for funds. It would be ironic if the ability of the Services to mount effective operations was restricted because of the financial burdens of one type of equipment. This would be even more so if the resulting lack of a balanced inter-service force meant that the uses of the expensive piece of equipment had to be severely restricted in the very conflicts for which it was designed.

Critics might plausibly argue that the concept of a destroyer sized vessel operating independently, or even in concert with another, in the open ocean or the island region to Australia's north has been rendered obsolete by developments in modern naval weapons technology. Technological responses to meet such developments may not be relevant to the Australian situation, given the small personnel base of its Services and the limitations of the Australian Defence Budget. Recent public statements by some senior defence officials can be interpreted to suggest that success in maintaining the technological level of the types of equipment which the Services have had in the past, is no longer as important a criteria of its relevance to Australian defence as it was. These statements indicate that reducing Service strengths in any one particular area may not be deleterious and may indeed contribute to the overall strength of the defence structure, if the resources so saved allow the development of capabilities which might otherwise have been neglected.

THE STRATEGIC FRAMEWORK FOR EQUIPMENT SELECTION

Many of the points developed in this paper suggest that it will be difficult for the RAN to maintain both the current level of its destroyer fleet and its professional and technological involvement in other areas of naval warfare. The implication of this is that the future equipment programs of the RAN should be more closely integrated into overall defence policy reflecting the need to balance capabilities within and between the Services. The overall strategy governing such equipment procurement policies is more obvious in wartime or in a situation, such as that of Israel, where the military threats to national security are apparent and urgent. In the Australian situation national defence policies can only be predicated on a range of probabilities some of which are more likely than others.

Yet today even the Super Powers cannot afford the forces to respond adequately to all of these probabilities and the task is clearly beyond the medium-sized powers such as Australia. Alternative solutions are needed. Senior Australian defence officials have publicly outlined those solutions which have been evolving over the last few years. In a speech earlier this year Sir Arthur Tange, Secretary of the Department of Defence, explained the viewpoints on which current Defence policies are being constructed. Developing his argument Sir Arthur said:

> "Absolutist views about Defence requirements are sometimes presented without posing and answering the question who is going to pay or, alternatively, what should be given up in order to find the resources to satisfy what is said to be a defence requirement. Moreover, voting more money for defence is not of itself a solution to anything. Australia's present and future task is to discern what kind of defence capabilities at the disposal of our Service Chiefs are more likely, and which less likely, to advance the security of the country .... The requirement is wise choice of particular capabilities – not simply more of the weapons or trained manpower which we know and have become familiar with in the past".[30]

Whilst it would be easy to categorize the Navy's concern to maintain the present numbers of its destroyer force as an example of over-concern with the familiar weapons of the past, this should be placed in the perspective that the Perry

Class program represents the culmination of more than 10 years' effort to define its requirements for a new class of destroyer, and predates the development of a more integrated Defence perspective. The RAN's hopes for another destroyer program should be evaluated in a different context. As Sir Arthur continued:

> ". . . it is my opinion that Australia is still in an historical transition towards a defence policy in which the structure of the Australian Defence Force, and in which our contingency planning for deployment of the force, are related more specifically than in the past to the defence of this country rather than to contributing to Australian expeditionary forces . . . The consequences of the transition are far reaching. They have involved the questioning of many assumptions which have accumulated over the years about the kind of forces Australia should have, and about their location".[31]

Talking to the same group, the Director Joint Staff extended Sir Arthur's observations to illustrate how the changing strategic concepts of Australian defence could affect the more detailed planning of the defence forces. "(These changes mean) that the arms of our Defence Force are more likely to be operating together as a joint Australian force rather than as in the past operating as individual services contributing to the efforts of the single services of our major allies".[32] Rear-Admiral Synnot acknowledges the difficulties of planning force structure in a time of "low or indeterminate threat"[33] but is confident that strategic guidance should give a good indication of the level and type of forces which are most suitable. He then goes on to explain the governing concept within which defence equipment planning is now evolving, that of the "core force":

> "The core force is one which must be able to undertake peacetime tasks; a force sufficiently versatile to deal with a range of the more credible low-level contingencies; a force with a necessary core of equipment, at a technological and numerical level, with which we can train and develop the military skills necessary as a basis for expansion which may be required to deter or meet a developing situation. Given adequate warning time, such a core force should be capable of expansion to meet the larger and more remote contingencies; this demands a flexibility in the kinds of military skills in the core force so that it can be expanded if necessary to meet a range of yet unidentified threats".[34]

It is within this context of the core force, therefore, that new purchases of defence equipment should be justified. In this context, the overall balance is more important than the absolute level of technological or professional capabilities in any particular area, since the justification of the core force is that its structure possesses the inherent flexibility to respond to the unforeseen. Projects which inhibit this capacity, which in effect place too many eggs in the one basket, should be closely scrutinised lest the cost of improvement in a particular area is the lesser development of the whole. The core force concept will not of itself automatically indicate the types of equipment which should be purchased. Each project must be the subject of study in its own right. However, Rear-Admiral Synnot indicated some of the requirements of the core force which would play an important role in these evaluations:

> " . . . The core force is a dynamic concept which should constantly react to changes in threat assessments, to shifts in defence policy, to advances in technology, etc.
>
> In relation to our small population, I mentioned the desirability of making the optimum use of modern technology in our defence force. . . A high level of technology in weapons and equipment can, of course, be very expensive, both in initial costs and in keeping it updated. It raises the question of quantity versus quality. However if, in addition to increasing the effectiveness of the equipment concerned, it offers savings in manpower, in life cycle costs or in avoiding early obsolescence, it would be well justified . . . In assessing the degree of technology to acquire, we should aim to maintain a favourable position relative to countries in our neighbouring region rather than relative to the world at large. At the same time, we must ensure that our weapons systems are technically able to operate with those of our major allies in fields where this is important".[35]

This framework defines the scope of the problem more tightly, and certainly allows the rejection of some alternatives, but is not in itself sufficient to dictate the detail of equipment choices. Costs still remain an important variable and some options may have to be rejected because of their total cost even though they may represent a more "cost-effective" solution than any other. Finally, the guidelines are not exclusive and can conflict with policy in other areas. For instance, a particular type of equipment may be preferred by the Services but be beyond the capacity of local industry to supply or service Recognising that the infrastructre provided by local industry is itself an important element of the core force,[36] greater balance in the structure of Australian defence might result if a lesser level of technology were accepted and the capabilities of the local industry improved.

HMAS LAVADA (now P.N.G.S. LAVADA) (Attack Class) —Defence Public Relations

The concept of the core force is only a guide and does not rigidly specify the precise nature of equipment for the Services. However, it does allow us to be more precise than to simply follow the habitual processes of attempting to replace old equipment on a one for one basis.

The Destroyer Force and Other Core Force Requirements

The concept of the core force provides the perspective in which to judge the value of the Perry Class programme and any future destroyer programmes. In terms of the technology which the Perry Class brings to the RAN, a strong case can be made for their usefulness in the development of the core force. As well, their increased efficiency frees manpower which theoretically could be used to extend expertise in other areas of defence. However, their *extreme cost* limits the Navy's ability to make use of this theoretical advantage. Any further destroyer programme based on the Perry Class can only compound these consequences of extreme cost, whilst at the same time contributing proportionately less to advancing the technological and professional expertise of the core force.

Critics can ask if a total of eleven destroyers are required to maintain and advance this area of technology within the core force. It could be that the naval capability required to meet any more credible low-level contingency and at the same time possess the technology and military skill necessary to permit expansion if required can be provided with a force of less than eleven ships. If this is the case and if the finance required to provide and maintain those eleven ships reduces the effectiveness of the core force, then it might be argued that the overall balance of Australian defence could be improved by developing other capabilities.

The argument of this paper is that imbalance within the core force will be hard to avoid in the next decade. Even within the RAN, problems will develop in the near future over the threatened loss of existing capabilities and the need to acquire new expertise. These problems cannot be eased by giving priority to those types of equipment which take the most time to procure whilst ignoring other equipments on the argument that they require less time to bring into operational service. Whilst this may be true, the concept of "lead time" is relative and often the most basic type of equipment takes many years to bring into service. It then takes several years for the Services to develop their operational doctrines and extract the most value from the equipment. For instance, the new class of patrol boat which is to be substantially bigger, faster and more sea-worthy than the Attack Class, will not begin to enter service until 1979, five and a half years after the project was initiated. Yet they will be a lightly modified version of patrol boats which have already been successfully developed and produced in overseas shipyards.

As already mentioned there are several vital areas of technology which will need money from the equipment vote during the same period as any likely destroyer replacement programme. Failure to have these equipments in service will result in a loss of expertise which will be increasingly difficult and expensive to redevelop the longer they are neglected. Perhaps the most significant (certainly the most expensive) of these will be maintaining the RAN's experience in operation of some form of seabone airpower after the retirement of *HMAS Melbourne*. This cannot occur later than 1985, and if it is found that the balance of the core force requires the continuance of this capability, action will have to be taken before the end of the decade to procure a successor. Payments for such a vessel would commence before the last years of the Perry Class programme and continue into the first years of the foreshadowed program to purchase more destroyers. Naval aviation is not a cheap activity, and new equipment to continue it could not be expected to cost less than $400m at present costs.

The state of the RAN's mine clearance force is perhaps even more troubling. Two of the RAN's six ex-RN minesweepers have been declared surplus and former Chief of Naval Staff, Vice Admiral Sir Richard Peek stated, in January 1975, that the remaining four craft will have reached the end of their service lives by 1977.[37] The RAN will then face the dilemma of operating increasingly inefficient and expensive craft (which may be a danger to their crews), or abandoning this area of military expertise for some time. It is already too late to have new mine counter-warfare ships in service by 1977. It is also improbable that they can be financed in the near future, against competition from other projects such as the tactical fighter force, stage II of the Army's "Rapier" SAM and the RAN's fleet replenishment ship and patrol boat projects, all of which have already been foreshadowed as priority projects requiring approval and a commitment of funds in the 1976-77 Budget.

It would be difficult to argue that countermine warfare does not have a role in the core force concept. As the mining and subsequent clearances of the Suez Canal and Haiphong Harbour showed, modern mine warfare is one of the cheapest and certainly most effective ways of disrupting an adversary's trade and communications. The increasing effectiveness of mines, both in destroying shipping and resisting countermeasures, has radically increased the level of technological expertise and cost of this military skill. Indeed, counter-mine warfare may no longer be a single technology, as each specific type of mine now requires a specific countermeasure. The range of technologies which the RAN should maintain to have the ability to counter mining may each require a specialized type of equipment and hence even greater funding.

The RAN has no expertise as yet in other areas of military technology and although some of them may at present be considered esoteric, others are forms of naval warfare in which the countries in our own region are already building great experience. One such shortcoming lies in the RAN's lack of fast missile-armed patrol boats. These vessels have proven themselves in short range exchanges in two Middle East wars and have been embarrassingly successful in SEATO exercises against larger RAN vessels. In our own area of concern, Indonesia, Singapore, Malaysia

'RAPIER' SAM

—Defence Public Relations

and the Philippines already operate, or will soon operate, missile-armed patrol boats. At the moment such craft appear to have a low priority in the overall framework of Australian defence. It has been implied that such vessels may follow the improved Attack Class replacement into service but this delays their introduction till well into the next decade.

As naval technology advances, strong arguments may be made for the Australian Forces to purchase, and develop doctrine for, equipment in new areas of technology such as hydrofoil patrol boats, hovercraft for both offensive and logistic roles, and the various kinds of "remotely piloted vehicles" which are now being developed in the United States. As Rear Admiral Synnot stated, the core force concept assumes the equipment purchasing policies of the Services will have the flexibility to change in response to new developments in technology.

As a medium-sized power, with an obviously limited defence budget, it may be unreasonable to expect the Australian Services to be among the first in new areas of military technology. However, if the core force concept is to work, defence planners should have sufficient flexibility to modifiy existing objectives when the advantages of new developments become apparent. If excessive adherence to earlier policies prevents the adaptation of the Australian forces to the environment of modern warfare, the core force concept will fail in its primary objective – to give the Australian forces the capability to expand to counter the likely threats of the future. If the core force planning fails to recognize the importance of finances and allow for this as much as for the imperatives of technology and Service experience, it will fail to maintain that balance which is necessary to allow for expansion to counter possible threats whose specific form cannot now be seen.

A defence critic might reasonably expect that any destroyer acquisitions subsequent to the Perry Class program should be justifiied in terms of the core force concept.

FOOTNOTES

1. Rear Admiral G.J. Willis, Chief of Navy Material, RAN in The Australian, 13 March, 1976.
2. Jane's Fighting Ships 1975/76, p. 33.
3. In the United States, the rate of inflation on capital equipment production has reached up to 35 percent per annum in recent years. See Edmund Faltermayer "The Hyperinflation in Plant Construction", Fortune, November, 1975.
4. Defence Report, 1975. p. 24.
5. Mr. W.L. Morrison "Statement on Defence", 28 August 1975, Hansard House of Representatives p. 715.
6. W.L. Morrison, Ministerial Report to the National Congress of the RSL 27 October 1975, p.6.
7. W.L. Morrison, op.cit. p. 5.
8. Defence Report, 1975, Table 19, p. 60.
9. D.J. Killen, Hansard House of Representatives, 4 March 1976, p. 527.
10. Defence Report, 1975, Table 12, p. 57.
11. D.J. Killen, Ministerial Statement on Defence, Hansard, House of Representatives 25 May 1976, p. 2385.
12. ibid.
13. Capt. B.H. Loxton, "DDL—the concept develops", Navy Quarterly October 1972, p. 12.
14. Rear Admiral A.M. Synnot, "DDL—the background", Navy Quarterly October 1972, pp. 10-11.
15. "The RAN FFG", Department of Defence Briefing, 12 March 1976, pp. 2-3.
16. Rear Admiral Synnot op.cit. p. 10.
17. Department of Defence Briefing "The RAN FFG", 12 March 1976 p.3.
18. Navy Quarterly, October 1972, p. 11.
19. Department of Defence Briefing; the RAN FFG, 12 March 1976, p. 11.
20. Department of Defence Briefing: The RAN FFG, 12 March 1976, p. 14.
21. At the time when the decision to proceed with the Perry Class program on the basis of construction of the ships in the US was announced it was claimed that the price involved was at least 16% less than a construction project in Australia—Mr L.H. Barnard, Hansard House of Representatives, 8 April 1974, p. 1107.
22. Mr. L.H. Barnard, "Australian Defence Estimates 1974/75" Statement Table in the House of Representatives, 24 October 1974, p. 13.
23. Mr. L.H. Barnard, Ministerial Statement on Defence, 9 April 1974, Hansard House of Representatives, p. 1236.
24. Mr D.J. Killen, Destroyers for the RAN, Hansard House of Representatives, 18 February 1976.
25. See, for instance, the specifications of the Dutch "Zuiderkruis" "Jane's Fighting Ships" 1974/75, p. 239.
26. A cruise height of 2-3 metres above average wave height, and a cruise speed of 300 metres/second, are typical.
27. Department of Defence Briefing: "The RAN FFG", 12 March, 1976. p. 5.
28. Captain H.H.G. Dalrymple "Inside the Patrol Frigate" Navy Quarterly Vol. 3 No. 4, Autumn 1975, p. 9.
29. Mr. L.H. Barnard, Statement on Australian Defence, Hansard House of Representatives, 9 April 1974, p. 1235 and Department of Defence Briefing: The RAN's FFG, 12 March 1976, p. 13.
30. Sir Arthur Tange, "Defence Policy Making in Australia", Address to Summer School, University of Western Australia, 13 January, 1976, p. 4.
31. ibid, pp. 4-5.
32. Rear Admiral A.M. Synnot, Director Joint Staff, "The Changing Challenge for our Defence Force", Address to Summer School, University of Western Australia, 14 January 1976, pp. 2-3.
33. ibid. p. 3.
34. ibid. p. 10.
35. Rear Admiral Synnot, op.cit. pp. 11-12.
36. Sir Arthur Tange, op.cit. p. 10.
37. A.W. Grazebrook "A Navy League View", The Navy, November, December, January 1975, 1976. p. 9.

I was there when...

A MYTH IS LAID TO REST

I WAS THERE WHEN the great broccoli myth of the Naval College was finally laid to rest.

At midday, seven days a week for three and a half years, we used to watch with grave solemnity the progress of the dish of broccoli. It would be carried out of the galley with due pomp and circumstance by a stony-faced steward and deposited in front of the head of the table. Then it would be passed down the length of the table and ceremoniously returned, completely untouched, to the galley. Sometimes though, a Cadet more daring than his fellows, would poke at it with his fork or whisper a ribald comment about it, and the others would laugh, nervously, and avoid each other's eyes.

Only once did we see anybody foolhardy, hungry or naively trusting enough to eat any, and this Cadet forced down a whole dish of it for a wager. Shortly afterwards he left the College, having been considered to lack officer-like qualities, and nobody was surprised for he really had exhibited remarkably poor judgement in this sensational feat.

We all knew, you see, that the broccoli was made of a greenish-yellow plastic–the sort of thing they sell in novelty shops like Frankenstein's feet or dog's you-know-what–and that the Chief Cook and Chief Victualler were working a racket. The Chief Steward had a piece of the action as well. It was clear to us that all the cooks did was to pour hot water over the stuff to make it steam and look real. I forget how the distinctive aroma was achieved, but it was probably contrived from some concoction based on hydrogen sulphide from the chemistry lab; Ras Berry was thought not to be above association with such a lucrative scheme. Anyway, when the broccoli was returned to the galley, the water was simply decanted and the dish would be ready for a repeat performance the following day. The whole deception was really quite ingenious, and quite safe too, for no Cadet would dare risk reporting the situation to Authority. (You see how early we are indoctrinated against the White Mafia). Meanwhile, the Chiefs waxed fat on their illicit profits and it did not go unnoticed when they bought new cars or threw lavish parties in the Chief's Mess on the hill.

Some years later, it was my happy lot to have a sojourn as Supply Officer at the College, and on my very first day I rushed to the dining hall in certain expectation that the venture would have been perpetuated. I would catch them red-handed and vindicate generations of Cadets' suspicions. Sweet nostalgia: there was the steward with his steaming dish of broccoli (plastic, all right, I could see at a glance); there was the Chief Cook with an odd expression on his face; and there were a hundred pairs of unblinking eyes hungrily watching their victualling allowance go back to the gallery.

I sprang forward to seize the incriminating evidence, but . . . mortification! The broccoli was genuine. I could hardly believe it but it really was the standard purser's issue, doubtlessly nutritious, but stewed to that unappetising and otherwise indescribable state which only institutions like lunatic asylums and naval training establishments can achieve.

Well, broccoli disappeared from the menu and the Chief Steward offered to put on crow instead in my special honour, but I failed to appreciate the humour in the gesture. (Chief Stewards are like that. The same droll comic observed that in its preparation, food was not touched by human hand. What he meant was that it was handled by cooks–the Chief Cook didn't think that remark too funny either.)

Now this account is true, but my contemporaries regard it somewhat sceptically. They explain that everybody knows that real broccoli is always used for a few days whenever a new Supply Officer joins, and they pointedly enquire how I was able to buy a new Mercedes a few months afterwards. Of course that is a slanderous irrelevancy, yet have they never wondered about the ubiquitous macedoine of veg?

DJC

The Impact of Technology Upon the Royal Navy 1860 – 1914 Part 2: The Torpedo

BY MASTER NED

In this second discourse upon technology, the Royal Navy and the role of the torpedo, my primary intention will be to derive a parallel between the development of the locomotive torpedo and the present day work on the surface-to-surface missile. Although many say that the SSM has, like the poor, been 'always with us', awareness of its potential has only been at any real level in the West since the sinking of the Israeli destroyer *Eilath* by Styx missiles some ten years ago. Thus the first effective Western surface-to-surface missiles have only been at sea for a few years and no body of doctrine and practice has yet been assembled. The use and future role of the SSM, whichever type this country eventually purchases, remain as particularly large question marks. Unlike our two previous break-points, the creation of the Fleet Air Arm in 1947-48 and the purchase of the Oberon Class submarines in 1963 -67, our patron allies have not yet assembled any information sufficient for us to use to make the decision to go into SSMs in a big way or not. With the aging fabric of *Melbourne* incapable of use past 1985 we alone must find our own salvation.

It is in this regard that a study of the development of the torpedo is important. Many of the pit-falls and draw-backs of that weapon are the pit-falls and drawbacks of the SSM; for instance the dangerous tendency to ignore the new weapon or the equally dangerous tendency to regard it as a universal panacea, a mistake that the French 'Jeune Ecole' were to lead their compatriots into making. It is by close study of such errors as these that we may be able to avoid being caught up in their equivalents of a hundred years after.

The locomotive torpedo came into being in 1868 when a Commander Luppis of the Austrian Navy and an English engineer named Robert Whitehead developed a depth-maintaining self-propelled torpedo. Although slow, unreliable, innacurate and unwieldy, the new weapon was soon improved to the extent that it could run on a set course for 3,000 yards at 28 knots. Twice as fast as the average warship and able to be mounted on the smallest hull, by 1870 the weapon was due to make an immediate and major impact upon naval warfare.

But it did not. What makes this the more astonishing is the technical situation that then prevailed. The iron-hulled battleship had only just come into existence, together with the rifled gun, and, at a blow, the non-industrialised nations of the world had been thrown out of the naval stakes. The big gun and the armoured hull appeared to be invincible and the smaller navies should have been looking for some new method of clandestine warfare. France, especially, still reeling from the devastating Franco-Prussian War had been forced to the conclusion that Britain could out-build her at a ratio of something like three to one. The equation of military strength had become too simple and the time was more than ripe for a variable, a 'surprise' element. It is thus astonishing that none of the major powers at sea took more than a passing interest in the device until Russia sought to find a means of attacking the Turkish fleet in the Black Sea during the abortive war of 1877. The acquisition of nearly 30 torpedo-craft by Russia forced Britain and France to make a reply in kind and orders for torpedo boats were hurriedly placed. However these vessels were all pitifully small and were generally only suitable for coastal defence. Some attempts were made to place 45' torpedo boats aboard battleships, whence they could be hoisted out for action but such craft were both too big for their mother ships' gear and, paradoxically, still too small for the tactical role demanded of them.

The gun was king, yet the weapon that would be the primary enemy of torpedo-craft, the quick-firing gun, was not perfected and did not go to sea in any numbers until 1888. In this interim period, and in fact right up to 1893, battleships and other heavy craft were terribly vulnerable. Many only mounted a few heavy guns which often had the staggering rate of fire of less than one round every five minutes! Even accepting that at a range of 4,000 yards or less every shell would hit (and in view of contemporary gunnery standards this was unlikely) a ship with a speed of 15 knots could travel more than half the distance in that time.

It would thus have been a logical development for the torpedo to be taken to sea in large numbers by ocean-going vessels. Strange to say, this opportunity was not taken up. Not until the late 1880s did a sea-worthy, built-for-the-purpose torpedo carrier commission and up to this time no ship carried more than a couple of torpedo tubes mounted one on each side. Although the torpedo still had problems, in large numbers and as an adjunct to the heavy gun it would have been a devastating weapon for any navy, a weapon that would not have required the massive expenditure that the heavy gun needed to get it to sea. In view of the popular 'knock out blow' theory that then held sway amongst the navies of the world it is all the more difficult to understand why the torpedo was not mounted in large numbers.

It would be far too glib to remark in explanation that the principal criminal in this 'conspiracy', the Royal Navy, was distrustful of anything that might destroy the status quo, for this argument has as its underlying assumption the idea that the status quo was satisfactory for Britain and this is itself open to much dispute. Although the Royal Navy possessed more armoured vessels than anybody else and had the capacity, given time, to build many more, the existence of coastal torpedo craft had already placed the long held doctrine of close blockade in jeopardy and technology had not yet given the Royal Navy the key to its successor. The enclosed waters of the Mediterranean and the Channel had now become areas of the utmost danger and, should war have broken out at this time, the consequences for Britain would have been incalculable. The rifle gunned battleship of its own was not enough and more was needed.

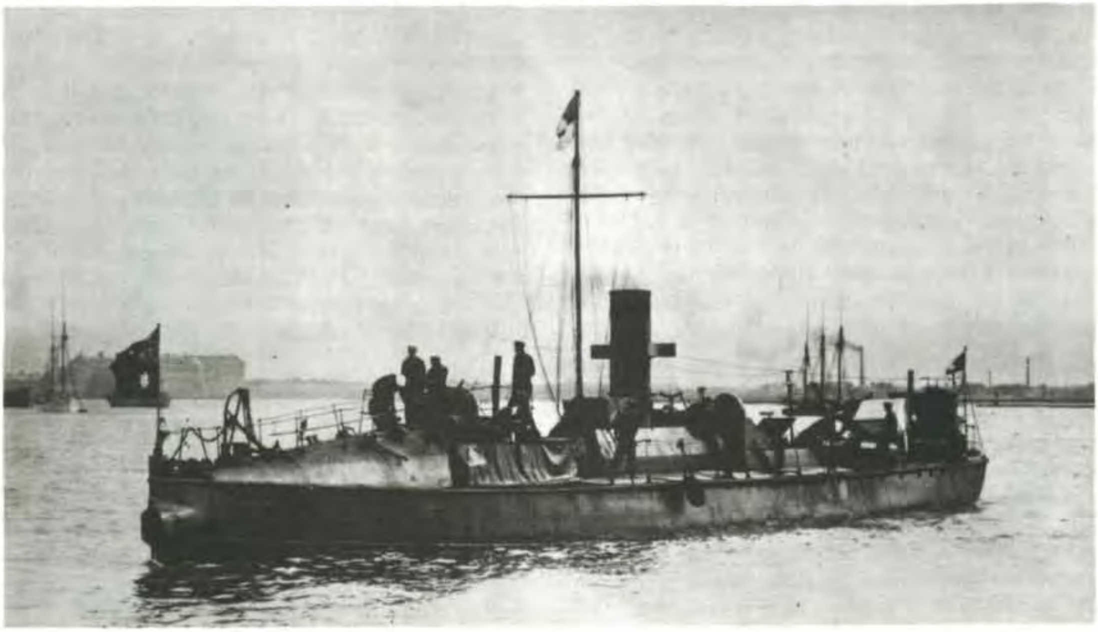
Yet nothing was done. Not until 1886 did the vessel designed to use both the ram and the torpedo, the *Polyphemus*, commission and the torpedo gunboat did not appear until 1889. Why, then, was the delay? It would seem to have been a peculiar admixture of complacent ignorance amongst some of the powers that be, a failure to appeciate the strategical realities of the time by many and a simple ignorance of the technology available by more. It was fortunate for Britain that she avoided a European war in this era.

It is also impossible not to see clear parallels with the situation of the Western Navies in the early 1960s. At this time it was becoming more and more obvious that the only navy able to take a truly capable air group to sea in any numbers was the American and that the Europeans were being left behind by sheer economic realities was also clear to see. The Vertical Take Off and Landing aircraft was only embryonic and would need enormous research and development before one could even operate from a sea-borne platform, let alone compete with conventional fixed wing aircraft. The Russian Styx missile was at sea and in such numbers that its designers must have placed great confidence in it; yet what did the Western Navies do? They could not follow the United States in this matter because the latter had made the reasonable decision (for itself) to continue with heavy aircraft carriers and the Western Navies were thus responsible for their own fates. Did they, however, move in any real way into SSM design and development? They did not, and for the same reasons as their predecessors of ninety years before. The shock of the *Eilath* was what triggered development and it is fortunate for the West that this was the only shock received.

When, however, the Royal Navy did finally produce ocean going torpedo carriers development proceeded apace and the torpedo-ram and the torpedo-gunboat were in turn discarded and soon replaced by the torpedo boat-destroyer. The first of the vessels, the *Havock* and *Hornet*, appeared in 1892 and in the next twenty years the specifications of the destroyer were to jump from 27½ knots speed with an armament of one 12-pounder, five 6-pounders and two 18" torpedo tubes to 35 knots with three 4" guns and four 21" torpedo tubes. In this time oil was to replace coal and the turbine oust the reciprocating engine. These vessels were soon to be an accepted part of the Navy and an integral portion of the fleet's defensive and offensive capacity. In these twenty years no accusation can be levelled as to the development of these vessels not proceeding at an adequate pace.

There can, though, be criticism of the methods of testing and exercise. Only three out of all the annual exercises that were held between 1890 and 1914 were conducted in at all heavy weather—'90, '91 and '95. The fabric and the seakeeping capabilities of the destroyers were rarely if ever tested and attacks were hardly ever pressed to a logical conclusion. Fleet commanders never tested out the relative merits of the turn towards and the turn away and it remained until the First World War for it to be discovered that

AN EARLY TORPEDO BOAT



—By courtesy of Australian War Memorial

HMAS COUNTESS OF HOPETOWN, 125 feet long, 75 tons, 20 knots. Originally built for the Victorian Flotilla. Transferred to the RAN on latter's formation and served on coastal patrols in World War I.

TORPEDO BOAT DESTROYER

—By courtesy of Australian War Memorial

HMAS HUON, 700 tons, 26 knots. This ship was building at the outbreak of World War I and served in the fleet until 1932.

black was a much less effective colour for night fighting than grey. This had gone unrealised in all the twenty years of 'realistic' battle practices and clearly demonstrates that the peace time war games left much to be desired. Although any new weapon must needs retain some of its mystery until fully tried and proven it should have been obvious much earlier than it was that the torpedo had changed the concept of the battle line in several crucial respects and the indecisive nature of the Anglo-German battles in the North Sea was to some extent a result of the ignorance of the various commanders as to the full capabilities and deficiencies of their light craft.

This aspect, that of the failure in following up and testing the various designs of the torpedo and its carriers is one of enormous relevance to our dealings with the SSM and its attendant paraphenalia. The expense of firings has led to the dangerous attitude among many that a dry run 'Bang.-you're dead' system is sufficient. Certainly a re-usable £20,000 torpedo was often considered to be too valuable to risk losing and an unrecyclable $900,000 SSM is even more likely to be regarded as an unusable, but we must recognise that the making of omelettes requires the breaking of eggs. The purchase of one hundred all-singing, all-dancing SSMs is useless unless we can be sure that a reasonable number are going to work in an action situation. This means more than the clear-day launch on the missile range, it means launching the weapon on a foul night against moving targets at frequent intervals by every ship, submarine and aircraft that is fitted with the system. Only by so doing, only by the expenditure of a significant proportion of the total purchase every year by realistic firings and the constant replenishment of stocks to make up the balance can we be sure that we have an effective weapons sytem. If we do not, then why should we buy it? This, above all, is the lesson that we need to learn from the early days of the torpedo boat destroyer.

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(In addition to the works cited in Part I)

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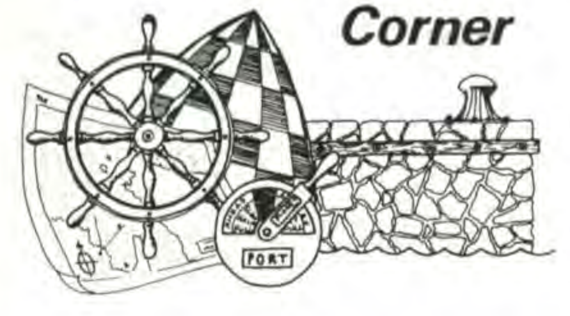
Master Ned has requested the following note be printed: "The first part of this series, 'The Battleship', published in the May 1977 edition of the Journal contained an error. Volume 3 No. 2, page 34, column 2, line 17 should read *Devastation* instead of *Monitor*. –*Editor*

THE POWER OF THE TORPEDO

—By courtesy of the Australian War Memorial

HMS BARHAM blows up on receiving three torpedo hits from U331 on 25th November 1941. The U-boat penetrated the destroyer screen as heavy units of the Mediterranean Fleet were steaming off the North African coast. This was the first British battleship sunk in World War II and resulted in the loss of the Captain and 861 officers and men.

Shiphandling Corner



The following Merchant Shipping Notice has recently been circulated by the Port of Singapore Authority to the local shipping community and has been forwarded by 'Mariner of Singapore' for the interest of members.

The attention of the Shipping Community is drawn to the U.K. Department of Trade, Merchant Shipping Notice No. M792 which is reproduced below for general information:

"INTERACTION BETWEEN SHIPS
Notice to Owners, Masters,
Pilots and Tug Masters

1 A number of casualties to ships have been caused or contributed to by the phenomenon of hydrodynamic interaction between ships in near proximity to each other. They have fallen into two categories: cases where ships were attempting to pass one another at very close range, due usually to their being confined to a narrow channel, and cases where ships have been necessarily manoeuvring in very close company for operational reasons. Particularly in the first type of case there have often been additional complications in the presence of bank suction or rejection, and of shallow water effect. (An appendix to this notice summarises the conclusion of recent laboratory work on this subject.).

2 So far as passing at close range is concerned, interaction is most likely to prove dangerous in overtaking cases, where there are two possibilities: the ship being overtaken may take a sheer into the path of the other; or the two ships may repel each other when they are abeam, causing the bows to turn away and the sterns to swing together. With a head-on encounter interaction is less likely to have a dangerous effect as generally the bows of the two ships will tend to repel each other as they approach. However, this can lead indirectly to a critical situation: in many cases the vessel will already be altering to starboard (assuming that a normal port-to-port passing is intended), when the effect is to increase the swing, probably causing port helm to be applied to check it: if the ship has now approached the edge of the channel and feels bank rejection a marked and possibly perilous port sheer will develop.

3 When therefore ships intend to pass in a narrow channel, whether on the same or opposing courses, (a) each ship should endeavour so far as possible to pass mid-way between the other and the edge of the channel; (b) any alteration of course needed to do this should be made in good time before the effects of interaction are felt; (c) the helm should be used quickly to counter any sheer and then smartly brought amidships ready to meet any reverse swing; (d) speed should be sufficient for it to be reduced without causing loss of steerage way, but below the maximum so that in an emergency some extra power is in hand to aid the rudder.

4 The other type of case, where ships are manoeuvring at close quarters for operational reasons, has most potential danger when one of the ships is a good deal larger than the other, and this most commonly occurs in normal merchant service operations when a ship is being attended by a tug. A dangerous situation is most likely when the tug, having been steaming alonside the ship, moves ahead to the bow as when preparing to pass or take a tow-line. Due to changes in drag effects, especially in shallow water, the tug at first has to exert appreciably more ahead power than the larger ship and this effect is strongest when she is off the shoulder. At that point also hydrodynamic forces tend to deflect the tug's bow away from the ship and attract her stern; but as she draws ahead the reverse occurs, the stern being strongly repulsed, and the increased drag largely disappears. There is thus a strong tendency to develop a sheer towards the ship, and unless the helm, which will have been put towards the ship to counter the previous effect, is very smartly reversed and engine revolutions very quickly reduced the tug may well drive herself under the ship's bow. Further another effect of interaction arises from the flow around the larger ship acting on the underbody of the smaller vessel causing consequent decrease in effective stability, and thus increasing the likelihood of capsize if the ships touch. Since it has been found that the strength of hydrodynamic interaction varies approximately as the square of the speed, this sort of manoeuvre should always be carried out at very slow speed indeed. If ships of disparate size are to work in close company at any higher speed then it is essential that the smaller vessel keeps clear of the hazardous area off the other's bow.

5 A recent casualty exemplifies the dangers. A cargo ship of some 1600 tons gross, in ballast,

was approaching a British port and was to be assisted to her berth by a harbour tug. The mean draughts of the ship and the tug were respectively 9'0" and 7'0". The tug was instructed to make fast on the starboard bow as the ship was proceeding inwards, and to do this she first paralleled her course and then gradually drew ahead so that her towing deck was abeam of the ship's forecastle, distant some 15-20 feet. The speed of the two ships was about 4 knots through the water, the ship steaming at slow ahead the tug, in order to counteract drag, at ¾ speed. As the tow line was being passed the tug took a sheer to port and before this could be countered the two vessels touched, the ship's stem striking the tug's port quarter. The impact was no more than a bump but even so the tug took an immediate starboard list, and within a few seconds capsized. One man was drowned.

APPENDIX

Extensive laboratory work was recently carried out on the combined effect of hydrodynamic interaction and shallow water (ie, depth of water less than about twice the draught) and the following conclusions, which accord with practical experience, were among those reached:

(a) The effects of interaction (and also of bank suction and rejection) are amplified in shallow water.

(b) The effectiveness of the rudder is reduced in shallow water, and depends very much on adequate propeller speed. The minimum revolutions needed to maintain steerage way may therefore be higher than are required in deep water.

(c) However, relatively high speeds in very shallow water must be avoided due to the danger of grounding because of squat. An increase in draught of well over 10% has been observed at speeds of about 10 knots, but when speed is reduced squat rapidly diminishes.

(d) The transverse thrust of the propeller changes in strength and may even act in the reverse sense to normal.

(e) Ships may therefore experience quite marked changes in their manoeuvring characteristics as the depth of water under the keel changes. In particular, when the under keel clearance is very small a marked loss of turning ability is likely.

Further information is available from the National Maritime Institute, Faggs Road, Feltham, Middlesex, who have recently completed a film entitled "Interaction" in co-operation with the Nautical Institute.

In our February 1976 issue (Volume 2 Number 1) 'Mariner of Lyneham' described an incident involving ship interaction and shallow water effect and asked readers if they had had similar experiences. Unfortunately no response has been forthcoming. Perhaps the above Merchant Shipping Notice will now stimulate other mariners to contribute to this column. – Editor

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HAVE YOUR AMBITIONS ELUDED YOU? THEN TAKE HEART

Some years ago, Field Marshal Lord Alexander was replying to the toast 'The Services' at the Royal Academician's Dinner. The burden of his initial address was as follows:

Gentlemen. When I was a young man I had three ambitions. The first was to play Rugby Union football for England, the second, to be awarded the Victoria Cross and the third to be a member of the the Royal Academy – well to be honest it was the President of the Royal Academy.

As you know, I did not play for England, I did not win a VC and I will obviously never become President of the Royal Academy.

Gentlemen. You see before you tonight a man who is a horrible failure.

B.D.W.

Weapons Change; Strategic Concepts Stay

BY A.W. GRAZEBROOK

Two hundred years ago, the merchant and agricultural colonists of what was to become the United States defeated the well-trained, well-equipped European armies of King George III. The colonists achieved their victory by employing methods for which the European-trained British were unprepared, in an environment to which the British were unaccustomed.

Some two hundred years later, General Giap employed successfully what were, in principle, the same methods in encouraging the United States to leave Viet Nam.

There are those who argue that, in an age of rapidly escalating complexity of weapons and attendant changes in tactics, it is all too easy to become totally immersed in the study of weapons technology and tactics. The basic points of strategic principle continue to merit attention. Many of these have applied for many centuries, through all the changes of weapons and vehicles. Many of these principles apply both to maritime, air and land warfare or combinations thereof.

These principles will always merit regular study not only for application by ourselves but also to ensure our own preparedness for their application by an enemy.

Examples of these principles include the advantages of striking together with surprise, speed and concentration. Hitler and Guderian combined two arms (Panzer Corps and tactical airpower) to apply these principles with conspicuous success against the Poles in September 1939, and the British, Belgians, French and Dutch in May, 1940.

Yamamoto used two arms (air and sea) and applied the same principles of speed, surprise and concentration at Pearl Harbour in 1941.

Another such principle is that of surprise alone–doing what is apparently illogical, or unexpected by your enemy. History gives us examples of this being achieved not only by arriving unexpectedly at the point of attack but by many other forms of surprise–unexpected choice of weapons, method of transport, or the use of "ruses de guerre". Examples range from the Wooden Horse at Troy to Hitler's pre-positioning of merchant ships, with troops hidden on board, in Danish harbours prior to his seizure of that country in April, 1940.

"We always seem to start fighting the next war where the last one left off" HRH Prince Philip is reputed to have said. In endeavouring to avoid this mistake, much Australian attention has rightly been paid to the consequences of our changed strategic situation, to the use of the constantly evolving weapons systems in that strategic environment and to the tactical uses of new weapons systems. All these changes have occurred –it would be most unwise to ignore them, and most unwise not to study them exhaustively.

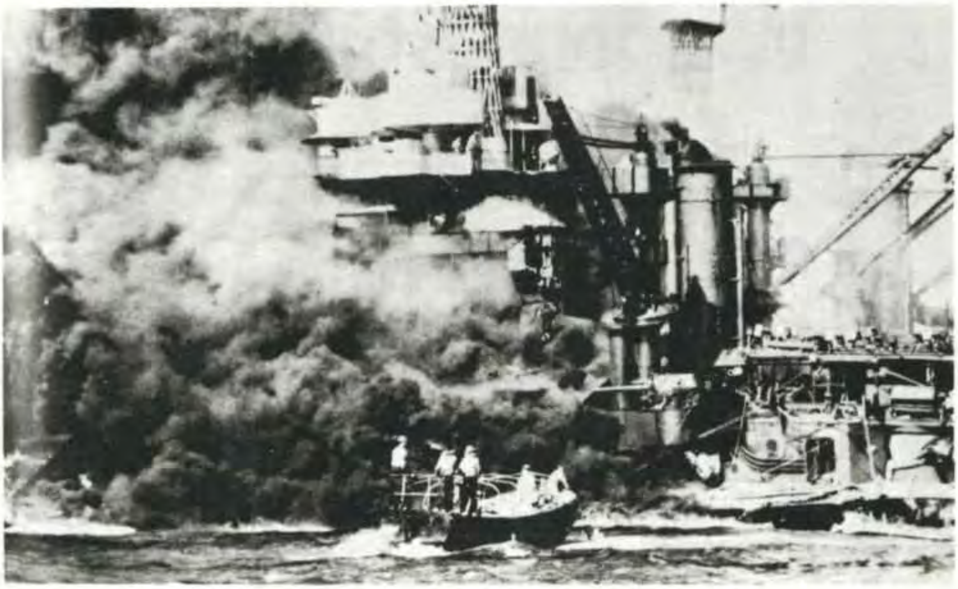
But is this enough? Should we not couple this detailed study of modern technology and tactics with a review of the principles involved in maritime warfare of the past? Should we not consider the possibility of a 1970s or 1980s re-application of the principles used in previous decades or centuries?

THE AUTHOR

Lieutenant Commander A.W. Grazebrook, RANR, was born in Britain in 1935. Educated in the United States and Great Britain, he has made his career in the marketing of synthetic rubber. Activities in this field have included extensive travelling in the Middle East, Eastern Europe and North America, and a period of five years' residence in Switzerland. He is now Marketing Manager, Australian Synthetic Rubber Co. Ltd., and lives with his wife and two children in North Balwyn, Victoria. Two years' National Service in the Royal Navy, followed by service in the RNVR and RNR preceded his transfer to the RANR as a Lieutenant Commander. He is also Federal Vice-President of the Navy League and Past President, Victorian Chapter, Naval Historical Society of Australia.

SURPRISE

PEARL HARBOUR – 7th DECEMBER 1941



—USN Official Photograph

The battleship WEST VIRGINIA sinking alongside the battleship TENNESSEE.

NORWAY 1940

—By courtesy of the Australian War Memorial

The German destroyer GEORG THIELE in a Norwegian fiord.

A glance through some of the maritime warfare campaigns of history highlights some of the possibilities for the future:

- Hitler's attack upon Norway in 1940;
- The United States' pursuit of a guerre de course against the British in 1812-1815;
- The British use of the mobility of seapower to surprise United States coastal facilities in 1812-1815;
- The use of submarines during the Spanish Civil War (1936-1939);
- Captain James Lancaster's descent upon Fernambuco in 1595.

NORWAY – 1940

The Norwegian campaign of 1940 has received extensive literary coverage. Much of this has been concerned with the many and hard fought land and naval battles, and the hard lessons learned by the Allies regarding the effectiveness of tactical airpower. The nature of the initial German onslaught is often forgotten.

Only six months after he had given the world its first demonstration of the effectiveness of the blitzkrieg, Hitler forsook the method he had developed and proven in favour of a combination of surprise, stealth and ruse de guerre.

In the face of greatly superior British and French naval strength, Hitler disregarded the principle of concentrating force at the decisive point. By dividing the limited German naval forces, Hitler applied surprise, ruthlessness and precision[1] in sufficient strength to make successfully six simultaneous landings at points from one end of Norway to the other. At no single point did the initial landing force exceed two thousand men.

Hitler took risks–at Narvik, one thousand miles to the North of Oslo, he made his assault without tactical aircover and facing the possibility of the British deploying one of their aircraft carriers in the area. In most cases, the initial assaults were made from warships or merchant ships. The problems involved in specialised amphibious craft transitting long ocean distances were overcome by surprise assaults to seize ports which, once secured, were used to disembark substantial forces (already on their way) by conventional handling equipment.

Within 48 hours, Hitler's initial landing forces, totalling twelve thousand men, had secured all the key cities of a nation of 3 million people.

Hitler intended to stay in Norway. The German landing forces were followed by much more substantial military strength–some seven divisions and eight hundred operational aircraft. Had he chosen not to stay, but simply to pillage or destroy, he could have done so with his initial landing force.

THE WAR OF 1812-1815

Many are surprised at being reminded that, in 1812, Britain found herself at war with the United States at a time when Napoleon I was at the very height of his power, and at a time when the French Navy, well on the road to recovery from the devastating defeat at Trafalgar, was approaching numerical parity with that of Britain.

The causes of the war between Britain and the United States are in themselves of interest.

In her desperate struggle with Napoleon, the British Navy stopped US ships approaching Europe, searched their cargoes, sequestered warlike or potentially warlike stores, and impressed the United States seamen for the Royal Navy.

President Madison sought and obtained a Declaration of War from the Congress. By attacking British trade, by forcing Great Britain to divert very substantial resources in defence of trade, James Madison sought to pressure the British into desisting from their harassment of US trade. Although some of his associates advocated territorial ambitions in Canada and Florida, Madison did not seek absolute victory over England. He sought to make the war so costly to the British that they would regard the cost of the concessions sought by the United States as cheaper.

However, Madison lacked strategic insight. He failed to foresee the opportunities for the British to wage raiding and commercial warfare upon the long, sparsely populated, lightly defended United States coastline.

Several years prior to the War, a Congressional Committee had favourably considered the construction of an additional fleet of twelve ships of the line and twenty frigates to guard the US coast. Recognising a general Congressional lack of enthusiasm, the Committee reduced their initial recommendation to the building of a dockyard and twenty frigates. The Congress voted down the proposal, allowing only a minute provision for the purchase of timber–a parsimonious error of judgement for which the US electorate were to pay dearly in both lives and money.

The US Navy's Atlantic force of four frigates, a sloop and a brig, supplemented by privateers, embarked upon a war upon British trade all over the world. Hundreds of craft were sunk.

The heavier (40 or so guns) US frigates, stronger than those of Britain (30 or so guns) when compared on a ship to ship basis, sailed all over the world. British trade was attacked in the Indian Ocean, off Brazil, near Tristan de Cunha, south of the Sunda Strait, off West Africa, in the approaches to the English Channel, near the coast of Chile, as well as along the full length of the North American coast.

Britain, with a Navy of some two hundred ships of the line and 250 frigates, had successfully blockaded most of the French Navy in European ports, and had largely scourged the seas of privateers. She now found herself forced into the crippling delays and expense of re-introducing convoys in the North Atlantic and West Indies. Large numbers of warships had to be diverted from the blockade of Europe and the convoying of supplies to Wellington's armies in the Iberian Peninsula. Substantial sums were appropriated for the construction of new frigates, big enough to cope with the big American frigates, the effectiveness of which the US Navy was demonstrating in a series of spectacular and victorious single ship actions which have justly been recorded in history as outstanding American achievements.

After the first few months, the British redeployed a number of ships, frigates and smaller craft off the US coast. There they found the US coastal trade unprotected (as it was in 1942) and took hundreds of mercantile prizes.

A British Squadron sailed up Chesapeake Bay—then a vital link in US internal trade. British prize lists included innumerable small craft laden with all manner of goods, ranging from artillery, through such staple items as hemp, rice, cotton, shoes and leather to luxury items including gin, oysters and whiskey. Landing parties destroyed not only military installations but also industrial plant, provisions and other items.

In June, 1814, a British force sailed up Buzzards Bay and the Connecticutt River destroying no less than forty American merchant craft. In August, a British force entered Washington, D.C. and destroyed those public, naval and military facilities that had not been burned by the Americans before their evacuation.

Fought on a relatively low key, without invading hordes seeking total victory and permanent subjugation, the War of 1812-15 is fascinating to historians for its examples (on both sides) of individual gallantry, military and naval ingenuity, and for its examples of diverse ways of the use of maritime power:

- the use of attack upon trade as a means of putting political pressure upon a nation dependent upon maritime trade;
- attack upon coastal traffic, economic facilities and towns as a means of reprisal and of putting political pressure upon a nation with a long sparsely populated coastline.

SUBMARINES AND THE CIVIL WAR IN SPAIN

Readers will recall that, in 1936, Spanish Falangists revolted against a Communist dominated government in Madrid. Much of the Spanish Navy, and the entire submarine force of twelve boats, sided with the Russian-backed Madrid government which was thus enabled to import arms and supplies from both Russian and neutral governments.

Powerless to stop the reinforcement and supply of their enemies, the Falangists turned to their Italian backers. Seeking a way to prevent supplies reaching the Communists without openly committing their forces to the War, the Italians deployed their submarines to blockade government-held Spain.

In November, 1936, an "unknown" submarine attacked a government squadron of one battleship, three light cruisers and a number of destroyers. One light cruiser was seriously damaged.

The following month "unknown" submarines began regular patrols against shipping approaching government-held ports.

Neutral merchantment found their flags gave no protection as British, Russian and Danish seamen realised when their ships were sunk without warning.

Although still without proof of Italian involvement, the maritime powers were aware that all Spanish submarines were in goverment hands. They deduced that only the Italians could be responsible. Diplomatic noise (no one dared to apply pressure) led to the Italians "selling" two submarines[2] to General Franco. After appropriate publicity for the "sale", these two submarines began patrols in May, 1937. All sinkings were claimed by the two Spanish boats, although many Italians continued their patrols and sank merchantment. The sinkings continued at a rate which could not possibly have been achieved by the two submarines in the Falangist Navy. The attendant restriction on supplies reaching the Spanish Communists had an increasingly deleterious effect upon their war capacity.

No major power dared to accuse the Italians publicly. It was not until September, 1937, (11 months after the attacks began) that an International Conference was convened at Nyon, Switzerland[3]. As no one dared to accuse them, the Italians had to be invited and agreed to contribute to the ASW patrols that the maritime powers involved (Britain, France, Italy, Yugoslavia, Greece, Russia, Roumania, Bulgaria, Egypt and Turkey) agreed to establish.

Unwilling to risk the much greater danger of exposure which the patrols involved, the Italians withdrew their submarines. The two Franco boats, aided by another genuine Spanish submarine (C2, which had been captured by the Falangists from the Communists) proved unable to stem a rapid increase in the supplies reaching the Communists. The Italians met this problem

RAN SUBMARINES LEAVING SYDNEY HARBOUR

–Defence Public Relations

by "transferring" four more submarines to Franco. These boats hoisted the Falangist ensign, but were Italian manned. Sinkings were resumed and were not confined to Republican ships. For example, eleven British ships were sunk or damaged in Spanish waters between April and June, 1938.

Another feature of the "neutral" Italian submarines in the Spanish Civil War is of interest. A study of the list of Italian submarines involved[4] shows that the Italians deployed not only their newer boats–the new PERLA Class were quickly involved–but also some of the older submarines which proved very effective against unescorted merchantmen.

The involvement of "unidentified" submarines re-emphasises a number of points of long term significance to Australia:

- When one side gets desperate, neutral flags are no protection against attack by "unidentified" submarines;
- Older submarines can be very effective against merchantmen—the latest electronics and propulsion systems are an advantage but not essential in this role;
- The political advantages to an aggressor of "unidentified" submarines;
- The ease with which a major power can operate submarines "icognito" on behalf of a client power.

FERNAMBUCO – 1595

"Captain James (by many called John) Lancaster was fitted out by some merchants of London to cruise on the coast of Brazil, then in the hands of the Spaniards. He sailed from Dartmouth on 30th November 1594, with three ships, one of 140, another of 170 and the third of 60 tons; on board these were 275 men and boys[5]".

After joining four more ships, "they took the city of Fernambuco on 20th of March, 1595, in a manner scarce to be paralleled in history; for Captain Lancaster ordered his fine new pinnace, in which he landed his men, to be beat to pieces on the shore, and sunk his boats, that his men might see they must either die or conquer; the sight of which so frighted the Spaniards and Portuguese that, after a very poor defence, they abandoned the lower town".

Lancaster's men held the town for thirty days, repulsing eleven counter attacks whilst they plundered. "The spoil was exceeding rich, and amounted to so great a quantity that Captain Lancaster hired three sail of large Dutch ships, and four Frenchmen to carry it home."

This relatively little known instance of the success of a relatively small force–the landing party cannot have numbered more than four hundred–is an interesting example of the combination of surprise and the concentration of sufficient force to overcome the defence for the short time necessary to achieve the objective–be that destruction, distraction, plunder, rescue or worrying an enemy into diverting resources to the defence of other possible points of attack.

Down through the centuries, there have been countless other examples of the use of maritime force in this manner–the Viking raids on the coast of England, Drake's attack on Nombre de Dios (1572), Captain Larken's elderly cruiser *HMS Doris* at Mersina on the Syrian Coast (1914)[6], the blocking of St. Nazaire (1942), the raid of Lofoten, and the Israelis in Alexandria Harbour (1967) are but a few.

WEAPONS CHANGE, VEHICLES CHANGE

Weapons change, vehicles change but many of the basic concepts of warfare continue through many centuries and many generations of weapons and vehicles. Some of the concepts outlined above have survived the invention of gunpowder, the introduction of steam propulsion, the advent of ironclads and the advantages of nuclear propulsion.

NUCLEAR PROPULSION
USS TRUXTON IN JERVIS BAY

–Defence Public Relations

The fact that we have this century suffered two world wars which resulted in total and utter defeat for one side should not be allowed to obscure the fact that, before 1914 and after 1945, a number of regional wars have been fought with the achievement of limited objectives or without conclusive victory or defeat. Examples include the Korean War, the three Middle Eastern Wars (1956, 1967, and 1973), the Indo-Pakistan Wars of 1965 and 1971, and the Indo-Chinese War of 1965. There have been numerous examples of fighting in lower keys.

It is this writer's view that it is erroneous to concentrate on a defence against the threat of all-out war. It is for this reason that the writer has chosen these examples from history. In concept, each offers a potential enemy an opportunity which he has the means to implement:

- The quick but damaging raid on coastal facilities–the use of both speed and surprise to concentrate the limited force necessary to overcome resistance for the short time required to achieve the objective;
- The use of submarines to apply political pressure by an attack upon trade.

More broadly, there is much to be learned from the invitation of the Italians to the Nyon Conference to join patrols against their own submarines. The Italians had to be invited because the diplomats could find neither the words nor the courage to expose the Italians' involvement in the submarine campaign in Spanish waters. Even then, diplomatic means never did succeed in preventing the Italian submarines from operating against neutral shipping. The delay (eleven months) in organising the Nyon Conference permitted heavy shipping losses–losses that would have been minimal if effective ASW patrols had been instituted immediately. The dangers, and cost in lives and ships, of relying too heavily on diplomatic negotiation are manifest.

FOOTNOTES

1. The Second World War by Rt. Hon. Sir Winston S. Churchill, Volume 1, page 532.
2. The Italian submarines *Archimede* and *Torricelli* became the Spanish submarines *General Mola* and *General Sanjurjo* in May, 1937.
3. The Sky Was Always Blue by Admiral Sir William James, p. 188 et al.
4. Warship International 3/73 page 329.
5. Lives of the British Admirals Down to 1779, Vol. 1, page 448 et seq. By Dr. J. Campbell. Printed by Alexander Donaldson, London, 1781.
6. Smoke on the Horizon by Vice-Admiral C.V. Usborne, London, 1932.

Nobody asked me, but...

Churchill, who usually had a bon mot for every occasion, once remarked that a good administration manifests itself in attention to small detail as well as to the larger issues.

Well, here is a detail to which the Chief of Naval Personnel might devote some little attention in between worrying about manpower ceilings and SAILSTRUC implementation. It's a small task but it would at once strike a blow against apparent illiteracy and another against the way people are relegated to alpha-numerics for the benefit of 18-year old Honeywells in the Defence computer complex.

I refer of course to that dreadful abbreviation, LEUT. This irksome term has invidiously pervaded a wide range of service and non-service publications–it crops up with aggravating frequency in Navy News, reminders for dues from the Imperial Service Club, the Navy List, Reports of Proceedings, the daily press, and it is even hallowed in JSP (AS) 101, the Joint Service Staff Manual Glossary.

At page 2-3-1 of this Glossary, we read that "officers' ranks have been standardized at four letters for each rank." Why? It's purely because it was deemed expedient for EDP reporting, presumably.

With so much standardization about, why do not Army and Air Force have to be limited to four letters as well and to suffer the same indignity? Army is permitted Lt for Lieutenant, and Air Force uses FLTLT for Flight Lieutenant (which is bad enough). But LEUT?

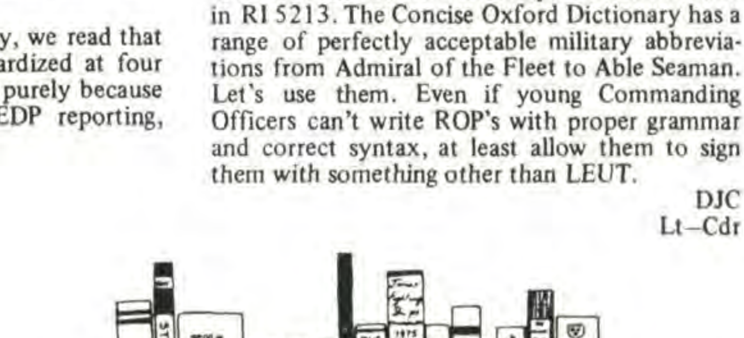
Abbreviations are handy things but there is no reason whatsoever why they have to be dictated by the constraints of the number of available boxes on EDP forms. Incidentally, if the computer can digest a six-digit MAJGEN or manage a two-digit AC (look that one up) then surely it is not beyond the bounds of technological achievement to cope with a LIEUT or LT.

But that begs the question. The real issue is that sensible, widely-used abbreviations should be used in general correspondence. It is well within CNP's (or is it CHFNAVPERS?) province to make it so.

To that end, please let's amend that obnoxious table in the JSP Glossary and include one in RI 5213. The Concise Oxford Dictionary has a range of perfectly acceptable military abbreviations from Admiral of the Fleet to Able Seaman. Let's use them. Even if young Commanding Officers can't write ROP's with proper grammar and correct syntax, at least allow them to sign them with something other than LEUT.

DJC
Lt–Cdr

BOOK REVIEW



'SEA BATTLE GAMES' **by P. Dunn**
M.A.P. Publications

A rapidly growing hobby is 'wargaming', especially in the Military area, and is also gaining strength in the Naval arena. Here is a good little book for the beginner to get his teeth into. Lots of rules for playing these games are given for various types of naval conflict ranging through early period times, Napoleonic Wars, Ironclad era and World Wars One and Two.

It is fascinating to read some of the passages where allowances must be made for such things as rates of fire, damage control, maximum turning circles, armour penetrations and so on. I liked this piece on rates of fire from Napoleonic times:

"The British could fire at least twice as fast as the French and Spaniards; the Americans could not fire faster than the British, but were better gunners".

The section then goes on to give scales to score by.

It is not likely that wargaming will replace chess but it could easily give it a fright. An 'Armchair Admiral' can re-create a battle of any period and, provided he knows his rules well, can decimate his 'enemy' without spilling blood.

Models are needed to give this hobby added interest and these can be made or, sometimes, purchased from appropriate hobby shops.

Because of the wealth of information contained concerning ships and weapons of different periods, the publication is a remarkable guide to the enthusiast, not only for wargaming but for historical reasons as well.

E. JFHAN

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ANNUAL GENERAL MEETING

The Annual General Meeting will be held on Friday 28 October 1977 at the R.S.L. National Headquarters, Constitution Avenue, Canberra, A.C.T.

AGENDA

1. Confirmation of Minutes of the Annual General Meeting held on 22 October 1976.
2. Business arising from the minutes.
3. President's Report.
4. Auditor's Report.
5. Election of the Officers of the Institute and the Ordinary Councillors.
6. Appoint an Auditor and fix his remuneration.
7. Other business.

ELECTIONS

Office Bearers:

The Office Bearers of the Institute are:

- a. The President
- b. A Senior Vice President
- c. A Junior Vice President
- d. A Treasurer
- e. A Secretary

Council

The Council of the Institute consists of:

- a. The Office Bearers
- b. Ten regular members known as Ordinary Councillors.

Qualifications

Only regular members may hold office.

Nominations

Nominations of candidates for election are to be signed by two members (regular or associate) of the Institute and accompanied by the written consent of the candidate. Nominations are to reach the Secretary by 14 October 1977. A nomination form is enclosed.

Voting

Only regular members may vote and voting must be in person at the Annual General Meeting; proxies are not allowed.

HONORARY SECRETARY

AUSTRALIAN NAVAL INSTITUTE

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(1) Payment should be made by 31 December 1977.

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* Members who join on or between 1 July and 30 September in any one year are only required to pay half the subscription for that year. Adjustment is made in the following financial year.

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AUSTRALIAN NAVAL INSTITUTE

NOMINATION FORM FOR ELECTION OF OFFICE BEARERS AND ORDINARY COUNCILLORS

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(block letters)

(2) ....
(block letters)

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(block letters)

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NB: To be in the hands of the Secretary by 14 October 1977.