EXECUTIVE SUMMARY

The Poisonous Environment Existing in the Royal Australian Navy during the period of the 1950s to 1980s

"Men become accustomed to poison by degrees"

Victor Hugo

Much time and effort has been expended by many ex-service organizations in Australia in their pursuit of appropriate recognition and medical support for veterans of the Vietnam and other wars Australia has been involved in on Australian Government Order. Through all of this, silent and lethal poisoning of RAN personnel has gone mostly unrecorded and unrecognized.

Many chemicals specific to RAN ships were used without provision of Personal Protection Equipment (PPE) which was not available, not used as it was not issued or, as in many cases, not considered necessary by Ship Departmental Heads is the basis for this paper.

The 'cocktail' of carcinogenic and dangerous solvents represented in the paragraphs below were used with little, if any positive control over exposure rates or protective equipment. From the simple matter of no hearing protection in machinery spaces to the inappropriate and unfettered use of carcinogenic and dangerous solvents as personal cleaning agents freely available in the shower and washing facilities onboard ships and their general acceptance as a general cleaning agent onboard ship. The somewhat haphazard and uncontrolled use of these chemicals, many acknowledged as carcinogenic and dangerous solvents used without PPE placed sailors at an unacceptable level of risk that has resulted in this current situation and may explain many of the medical conditions Naval Veterans are now experiencing.

This situation requires an urgent government/expert review of the environment existing in the Royal Australian Navy during the period of the 1950s to 1980s and the effects it had on sailors serving during that period. This was, in many instances, a period of ignorance in the ships of the RAN as to the effects these chemicals wrought upon those who used them. The total range of chemicals and their effect both accumulatively and individually has to be established with the resulting problems such exposure would have caused.

Chemicals listed in the paper are by no means the definitive list. But point to the plethora of chemicals used to which RAN personnel were exposed to during their period of service no matter in which RAN ship they served.

Vietnam Veterans Federation

ACT Branch

Page

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BRIEF

The Poisonous Environment Existing in the Royal Australian Navy during the period of the 1950s to 1980s

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Aim

The aim of this research paper is to inform the reader of the toxic work environment existing in the Royal Australian Navy (RAN) during the 1950's and 1970's, possibly into the 1980's and the work practices of the time.

General

Exposure to toxic chemicals can cause any of several negative effects on human health, such as cancer or birth defects. Some chemicals are widely recognized to be hazardous, while others are only suspected, so these are always distinguished between "recognized" and "suspected" health threats.

Toxic chemicals can pose threats in many ways. How bad a particular chemical is depends on whether you are most concerned about its effects on humans, or its persistence in the environment, its damaging effects on ecosystems, or another factor. Publicly available scorecards show how a chemical stacks up comparatively under different ranking systems in use in different countries. They then spotlight the chemicals that are most dangerous to human health and to the environment.

If an industrial chemical is allowed by law to be released into the environment, most people assume that it must have been tested and evaluated for its potential risks. Unfortunately, this is simply not true. Keeping chemical hazards under control requires information about what kinds of hazards each chemical poses. If the basic tests to check on a chemical's toxicity haven't been conducted, or if the results aren't publicly available, previous and current laws tend to treat that chemical as if it were perfectly safe. For the chemicals being used in large quantities, Scorecards tell you whether or not eight basic types of tests for health and ecological effects have actually been conducted, based on the public record.

To date, it has been difficult if not impossible to easily obtain information about the types of health hazards posed by toxic chemicals. While some national and international regulatory agencies have generated lists of carcinogens and developmental and reproductive toxicants, these are often difficult to find and link to sources of information about chemical releases or exposure. If one is concerned about other important health effects - such as neurotoxicity or endocrine disruption - the lack of information is even more serious, as no authoritative scientific or regulatory agencies routinely categorize toxicological evidence in an attempt to identify these types of health hazards.

An extensive review of the scientific literature and toxicological databases has been conducted to create lists of chemicals with evidence of a potential to adversely effect human health. These lists cover the following types of diseases or adverse impacts on specific physiological systems: cancer, cardiovascular or blood toxicity, developmental toxicity, endocrine toxicity, gastrointestinal or liver toxicity, immunotoxicity, kidney toxicity, musculoskeletal toxicity, neurotoxicity, reproductive toxicity, respiratory toxicity, and skin or sense organ toxicity.

The weight of toxicological or epidemiological evidence supporting suspect hazard identification can vary significantly between chemicals. For example, evidence from two different laboratory species indicates that acetonitrile can cause cardiovascular toxicity. In contrast, there is overwhelming evidence that carbon monoxide causes cardiovascular toxicity in humans. These differing amounts of evidence both lead to designation as a "suspected" toxicant, because no agency authoritatively compiles lists of cardiovascular toxicants. Identifications made by regulatory agencies or scientific references have often undergone peer review, but no administrative process has occurred that allows debate over the toxicity of a chemical to be resolved conclusively.

Health effect data sources rarely specify if a chemical is a health hazard by a specific route of exposure (for example, hazardous if inhaled, but safe if ingested). If there is evidence that a chemical can cause a health effect, this information generally assumes the chemical is a potential hazard by all routes of exposure.

These differences in amount of evidence and uncertainties about health effects will result in substantially greater debate about the validity of suspected health effects lists than about its lists of recognized hazards. In many cases, there may be conflicting studies: some of which indicate an ability to harm health, and some which found no effect. Lists of suspected toxicants represent a screening-level evaluation of a chemical's capacity to adversely effect human health. The amount of evidence of reported adverse health effects is sufficient to comprise a strong "hazard signal" that warrants further action. The burden of proof should be on those who release these chemicals to the environment to produce toxicological evidence that demonstrates that these substances do not pose human health risks.

Background

Responsibility for maintenance of the ship's fuel systems, its tanks (painting and cleaning) lay, in the first instance, with the ship's Engineering Department. Also the department was responsible for the hull and all associated machinery and systems. The Navy's use of toxic chemicals for a myriad of ship technical tasks and the lack of; or provision of; Personal Protection Equipment (PPE) which was not available, not used as it was not issued or, as in many cases, not considered necessary is the basis for this paper.

Cleaning Ship's Fuel Tanks

Furnace Fuel Oil (FFO)

FFO (NATO Code F-77 and F-82) consisted of the residues from refining operations, with lighter distillate added to give the specific viscosity. The FFO contained two hugely undesirable elements, sulphur and vanadium. The FFO may have contained up to 3.5% sulphur but no limit to the vanadium content could be specified. FFO vapors were inhaled during long periods in both large and small tanks during cleaning, after internal ship spillage, chipping, wiping and scraping activities. In those days ships were supplied with 'bags of rags' for wiping up spills and general cleaning in the machinery spaces, they consisted mainly of torn up old clothing. When the sailors blew their nose to clear them into the rags that they had been using as a mask, the mucus was discoloured by 'dust' and other airborne particles. Respiratory protection in the form of face masks or breathing masks were not issued to personnel undertaking these tasks. Usually these tasks were carried out with poor ventilation (if any) during the activity with FFO leaching out of the pores of men's skin for days after completion of the work. Most times ventilation into a tank took the form of an air fan. These were electric centrifugal fans that drew air from the compartment in which they were placed; (usually adjacent to the access for the tank being cleaned) this air was then 'pumped' into the tank (without being filtered) via flexible tubing. There was no regulation of the air flow and most times the tube was placed just inside the tank entrance only; this due to the length of tube and the construction of the tank. Such a configuration did not establish a flow of fresh air, as usually there were no exhaust fans fitted or supplied at an alternative access to establish a clean, uninterrupted flow of air. Daily test for air purity were not carried out.

Fuel, lubricating oil, water and ballast tanks ranged in size from enormous, such as those on HMA Ships Supply, Sydney and Melbourne to small with intricate sub-compartments formed during the ship building process. Many had only one entry point and no provision for ventilation except for a permanently fitted ‘breathing tube’ that enabled air to expel or be sucked into the tank during the motion of the ship. Many breathing tubes were fitted with ‘Flash Guards’ that theoretically prevented flame from entering the tank subsequent to a fire or explosion. They were not provided to support the life of cleaning teams.

Partially flooding with seawater and adding the required cleaning chemical through the tank’s access hatch began the cleaning process for most ship’s fuel tanks. The tank was resealed and the normal roll and movement of the ship sloshed and agitated the water in the tank thereby cleaning the tank. The residue was in most cases pumped over the side well out to sea. However, the pumps could not remove all the sludge produced by the process. In the case of HMAS Supply this was removed by hand. Sailors were used for this task, placed in teams, they would enter the tank without any personal protection equipment or positive ventilation in the tank to ‘huck out the sludge’. The slurry and sludge was pumped out until the suction failed, leaving around 18 to 24 inches in the bottom of the tank. Sailors entering the tank and using buckets to fill a 44 gal drum, or smaller; depending on the size of the access. This ‘drum’ was winched out and emptied, thus removing the remainder. As the sludge became less it was mopped up with rags. The solvent used was GAMLEN X, which, I am of the opinion, has since been identified as a proven carcinogenic and removed from the market in the form used during the 60's and 70's.

Aviation Fuel Tanks (HMAS Melbourne)

Military Aviation Turbine Fuels (MATF’s) including F–34 (JP–8), (JP–8+100) and F–44 (JP–5) were developed to improve the characteristics of the older forms of aviation turbine fuel (eg F–40, AVTUR and AVGAS, NATO F-75 and F-76) and are used within Defence for all turbine-powered aircraft. As with all petroleum based fuels, there are concerns relating to some components, particularly benzene (a known carcinogen) and n-hexane (a known neuro toxicant). Although widely used for some time, the human health hazards associated with aviation fuels are not yet fully understood and research into this is ongoing. Female members of current RAN crews are currently banned from ship’s fueling and cleaning activities.

Military Aviation Turbine Fuel (MATF) was usually handled within a closed loop system (therefore minimal fuel/body contact), however incidental exposure would occur. In instances where handling of MATF was required outside of a closed system (eg daily drains) suitable PPE based upon an appropriate risk assessment, should have been used. Such PPE items should include; *Eye Protection, PVC Gloves, Clothing and Foot Protec-*

tion.

Exposure to MATF either as a vapour, aerosol or liquid in a confined space (or any other area exhibiting a high concentration of fuel) should have necessitated the wearing of appropriate respiratory protection for that environment (eg air supplied). In the event of skin exposure from MATF's, the affected individual should immediately shower and remove the contaminated clothing. However, the usual practice was for the tanks to be cleaned by hand with no PPE and little, if any ventilation.

Davy Safety Lamp

Before entering any confined space such as a fuel or water tank the atmosphere was tested for explosive gases. Ship's Staff through use of a Davy Safety Lamp accomplished this task. This lamp only detected 'explosive mixtures' and foul air, not the exact level. The level was decided by viewing a flame and making an 'arbitrary guess'. Not the actual presence of specific gases/fumes that may be hazardous to the personnel working in the tank. When RAN Ships were entering into maintenance they would be required to gain a 'Gas Free' certificate before work could proceed. An Industrial Chemist, licensed for such a declaration, supplied this certificate. Being 'Gas Free' of itself did not mean that ships tanks were fit for personnel to work in as the certificate only covered 'explosive mixtures'. Use of the safety lamp was prior to entering a confined space, but was not used again unless the tank had been resealed for a period greater than eight or twenty-four hours. No monitoring of the quality of air in the tank or confined space was taken on a daily basis and no monitoring of aerosol particles was undertaken. If memory serves, the use of the safety lamp was detailed in BR3001 and may have been transferred to BR 3109 during the course of a rewrite by the RAN.

But it is to be noted that the indicators for 'foul air' and the 'indication of inflammable gas' relied on descriptors and colour photos of dubious quality in the BR. Interpretation of the descriptors was at the whim and experience of the sailor conducting the test. Indication of 'foul air' only indicated that the air present did not contain sufficient oxygen to support life. It did not indicate toxic gases, only flammable gas.

ICABA Smoke Mask

Originally designated as a 'Pattern 5225 Distance Breathing Apparatus, the ICABA facemask was designed to provide the wearer with a continuous supply of fresh air when used for rescue work in compartments containing vitiated air, or for work in enclosed unventilated spaces. It was supplied with either 9 or 18 meter lengths that could be coupled up to a maximum length of 36 meters. For beyond that length breathing would become difficult and affect the wearer's ability to conduct tasks.

Its limitations and cleaning routines were detailed in BR 2170, (Royal Navy 1988). This was the RAN Ship's NBCD Manual (Naval Nuclear, Biological and Chemical Defence and Damage Control, including Firefighting).

HMAS Supply

As you may be aware, Supply was a tanker that supplied FFO, Diesoline and Aviation Fuel to the fleet whilst at sea. With the phasing out of FFO, Supply carried diesoline. However, what has not been mentioned or described to you is the method of tank cleaning and the chemicals used to achieve a 'gas free' situation on the ship before maintenance periods. This activity used a chemical to clean the tanks; it was Gamlen 'X'. This marine industrial chemical was withdrawn from sale as it is a 'proven carcinogenic' and the RAN used it to clean and 'gas free' Supply. Along with Gamlen 'X' was Gamlen 'D' and Gamasol and Turco. Most of these chemicals were obtained in Singapore in bulk (four and forty-four gallon drums) when the ship took on fuel at the Singapore Fuel Facilities.

The tank cleaning system was called a Butterworth Tank Cleaning System and may be described as – A mechanical device used for the purpose of cleaning oil tanks by means of high-pressure jets of hot water. The apparatus basically consists of double opposed nozzles, which rotate slowly about their horizontal and vertical axis and project two streams of water through all possible angles against all inside surfaces of the space being cleaned. The tank washing machines can deliver sprays of water at various temperatures and pressures that are indicated by the type of cargoes and the reasons for cleaning (quick bottom wash through gas-freeing and tank entry for hot work).

During use of the tank cleaning gear and when the Butterworth System had completed its work, the tank was pumped out through a separator system, the clean water being returned to the sea whilst the sludge remained in holding tanks until it could be discharged ashore at a proper facility. However, the pumps could not remove all the sludge produced by the process. This was removed by hand. Sailors were used for this, placed in teams they would enter the tank without any personal protection equipment or positive ventilation in the tank to 'huck out the sludge'. The slurry and sludge was pumped out until the suction failed, leaving around 18 to 24 inches in the bottom of the tank. Sailors entering the tank and using buckets to fill a 44 gal drum, which was winched out and emptied, removed the remainder. As the sludge became less it was mopped up with rags. The solvent was GAMLEN X, which, I am of the opinion, has since been identified as a proven carcinogenic.

Sailors Tank Cleaning Routine

The process for cleaning FFO Tanks and bilges was simple. The surfaces of an FFO fuel tank were sprayed with Gamlen detergent in the manner described above, in Butterworth Tank Cleaning System paragraph. The temperature of the detergent and water mixture was about 50 deg C (120 deg F) and a pressure of 130 lbf/in2. The oil and sludge washed off from the tank sides, together with the detergent solution, was cleared from the compartment via vacuum pumps called the ‘Stripping System’. After the stripping system ceased to function the Ship’s company would then complete the work by scooping up the FFO sludge and detergent mixture in buckets. These buckets where then emptied into 44 gallon drums cut open for the purpose that were then hauled to the top of the tank by pulleys to be emptied into a sullage/ullage tank. When this was no longer possible ship’s company completed the work by wiping the compartment by hand with rags.

For this activity members of the ship’s company were formed into teams and into a ‘three watch’ system. Half of the team on deck at the top of the tank, the other half in the tank at the bottom. Each watch was of four-hour duration with each individual spending at least two hours at the bottom of the tank. Some of the main tanks were over sixty feet deep. There was no ventilation provided either fixed or temporary. Tanks were ‘vented’ before entry after use of the Butterworth System. This venting consisted of opening the tank’s large hatches situated on the deck head of the tank, there was usually two of these situated one at either end of the tank and relied on the ‘Venturi Effect’ of air passing over the hatches to ventilate the tank. This is not an effective ventilation system.

Cleaning of Diesel and AVCAT Fuel Tanks followed the same routing except for hot detergent temperatures that were lower owing to the comparatively low flash point of the fuel.

Camlem and Turco Cleaners

Not only were these two cleaners used in the tank cleaning process, they were on many occasions used for general cleaning including one’s self when showering after completing dirty work. You would usually find a drum of such chemical in HMAS Supply’s bathrooms, especially during and just after tank cleaning. The author has personally been wiped down with Gamlen and Turco during his time cleaning tanks as he has wiped down others before proceeding to the showers.

Sailors only wore boots and overalls, as it was too hot in the tank. By the end of the cleaning duty there was no part of the body that was not covered in a film of FFO and GAMLEN X. Other solvents were used including GAMLEN D and GAMASOL. These produced rashes and burnt the skin. Despite this, washing in GAMLEN X & D was the only way to get clean as soap and water was ineffective. Fellow sailors would wash each other in the undiluted solvent. Despite showers afterwards, you ' smelt like a chemical factory for a couple of days’.

Fuel Tank Environment Testing

Standards, ‘Exposure standards’ means an airborne concentration of a particular substance in the worker’s breathing zone, exposure to which, according to current knowledge, should not cause adverse health effects nor cause undue discomfort. The exposure standard can be of three forms; time-weighted average (TWA), peak limitation, or short term exposure limit (STEL). Exposure to MATF should have been controlled in accordance with the Material Safety Data Sheets (MSDS) available at the time. Criteria for exposure standards were not known to Ship’s Staff or if they were; they were not promulgated or enforced. Adherence to such standards as Exposure Limits of 5mg/m3 as an oil mist or for vapour at a specified maximum of 100 ppm is not possible where test or surveillance equipment was not available.

Agent Orange

In December 2002 the DVA commissioned a report titled “Examination of the Potential Exposure of RAN Personnel to Polychlorinated Dibenzodioxins and Polychlorinated Dibenzofurans via Drinking Water. A report to the Department of Veteran Affairs, Australia.” The report is long and very detailed, but in short it proves that members of the Ship’s Companies of RAN ships deployed to Vietnam waters during the war were exposed to the ‘Agent Orange’ toxins at unacceptable levels by consuming potable water which had been produced by evaporative distillation of estuarine Vietnamese Waters.

The report, in the main, has not been challenged by DVA. In point of fact, flowing from the report a number of Statement of Principles (SOPs) have been rewritten to reflect the contents of the report and others are under review.

However, further matters are yet to be taken into account and placed in context within the report. If water contaminated with 2,3,7,8-tetrachlorodibenzodioxin (TCDD, the main contaminant in “Agent Orange”) is put through the evaporators it will co-distill at rates of 38% > 95% with the first 10% of the water distilled. (The presence of TCDDs in the waters off South Vietnam has been reliably established by the research of *Baughman & Meselson 1973*, into the TCDD concentration in fish in South Vietnam, an estimate of the fish lipid concentration of 2.5%) So the distillation process picks up the 2,3,7,8-tetrachlorodibenzodioxin present in the source water (the brown estuarine water) and puts it in drinking water tanks (portable water) with the drinking water. The water returned to the estuarine water around the ship is then relatively free of TCDDs as most of the TCDDs are now in the water tanks and the normal ebb and flow of the estuary provides more contaminated water to the evaporator intakes in the ship’s hull.

Fresh water obtained from the distillation of contaminated brown estuarine water was used exclusively as drinking water and fresh water obtained from the distillation of clean 'blue sea water' offshore was reserved as feed water for the boilers.

TCDDs co-distill at a greater rate the less turbid (less suspended solids) the water is. Co-distillation rates for water taken from the Brisbane River were in the order of 48 > 60% for the first 10% of water distilled. I don't recall the visibility at Vaung Tau being as bad as the Brisbane River, so the co-distillation % could be expected to be higher at the Vaung Tau anchorages.

The regular spraying of the mangroves in the Vaung Tau anchorage with Agent Orange would suggest that TCCDs in the anchorage area would be greater than the results of the research of *Baughman & Meselson 1973,* into the TCDD concentration in fish in South Vietnam would suggest.

The report points out that as this is the "potable water" it was used for drinking, showering and cooking. So it was eaten, drank and washed in. The thing not mentioned in the report is that cloths were also washed in it. If the contaminant TCDDs remain in the cloths after drying it is possible that in the hot and humid environment on deck in Vietnam and the even hotter conditions in boiler rooms, the TCDDs could have "aero soled" and become a respiratory danger as well as being in close contact with the skin when the skin is hot and sweaty with open pores.

The DVA has held meetings to investigate whether health problems affecting the personnel who served onboard HMAS SYDNEY and The Escorts could be connected with toxins directly digested into their bodies through the food and water supplies.

The mortality rate amongst all veterans is 1.07% which means it's 7% higher than the general population in the relevant age groups. The study was carried out by the National Research Centre for Environmental Toxicology and the Queensland Health Services for the Department of Veterans Affairs. It was found that <u>Prostrate Cancer</u> (1.53% or 53% higher than the average) and <u>Lung Cancer</u> (1.29% or 29% higher than the average) are the main points and concern dioxins have been directly linked to these diseases.

The breakdown amongst the services became even more surprising:

ARMY 1.00% considering their supposed fitness level it should have been 0.94%
RAAF 1.12% 12% above average
RAN 1.37% 37% above the average

So the navy became the main focus of most concern then the breakdown in areas of service in South Vietnam incurred to some extent more surprises:

Clearance Drivers	1.76%	76% higher than average	
SYDNET & ESCORTS	1.45%	45%	“ “ “
Gun line	1.23%	23%	“ “ “
RAN Helo Flight	1.20%	20%	“ “ “
Other RAN	.35%	65% lower than expected	

The distribution of navy figures when reviewed against the tasks undertaken and the geographical locations of the tasks clearly shows that exposure to the dioxins is directly linked to the marine environment in which the RAN assets were operating during the Vietnam Era. (i.e. divers spending more time in and under the water)

I am indebted to Dr Roderick Bain MBBS FRCA FANZCA, RSL NSW State Vice President (Southern Country) and RAN Medical Officer (Rtd) for his information regarding Exposure to Agent Orange linked to prostate cancer in Vietnam Veterans by the University of California Davis Health, the University of California Davis Health System is reproduced here in full as available on the Universities Web Site.

Public release date: 5-Aug-2008
Contact: Karen Finney
karen.finney@ucdmc.ucdavis.edu

REFERENCE: University of California Davis Health System
SACRAMENTO, Calif.)

UC Davis Cancer Centre physicians today released results of research showing that Vietnam War veterans exposed to Agent Orange have greatly increased risks of prostate cancer and even greater risks of getting the most aggressive form of the disease as compared to
those who were not exposed.

The findings, which appear online now and will be published in the September 15 issue of the journal Cancer, are the first to link the herbicide with this form of cancer. The research is also the first to utilize a large population of men in their 60s and the prostate-specific antigen (PSA) test to screen for the disease.
"While others have linked Agent Orange to cancers such as soft-tissue sarcomas, Hodgkin's disease and non-Hodgkin's lymphoma, there is limited evidence so far associating it with prostate cancer," said Karim Chamie, lead author of the study and resident physician with the UC Davis Department of Urology and the VA Northern California Health Care System. "Here we report on the largest study to date of Vietnam War veterans exposed to Agent Orange and the incidence of prostate cancer."

Chamie also said that, unlike previous studies that were either too small or conducted on men who were too young, patients in the current study were entering their prime years for developing prostate cancer. There was also the added advantage that it was conducted entirely during the era of PSA screening, providing a powerful tool for early diagnosis and tracking of prostate cancer. More than 13,000 Vietnam veterans enrolled in the VA Northern California Health Care System were stratified into two groups — exposed or not exposed to Agent Orange between 1962 and 1971. Based on medical evaluations conducted between 1998 and 2006, the study revealed that twice as many men exposed to Agent Orange were identified with prostate cancer. In addition, Agent Orange exposed men were diagnosed two-and-a-half years younger and were nearly four times more likely to present with metastatic disease. Other prostate cancer risk factors — race, body-mass index and smoking — were not statistically different between the two groups.

"Our country's veterans deserve the best possible health care, and this study clearly confirms that Agent Orange exposure during service in Vietnam is associated with a higher risk of prostate cancer later in life," said Ralph de Vere White, UC Davis Cancer Centre director and a study co-author. "Just as those with a family history of prostate cancer or who are of African-American heritage are screened more frequently, so too should men with Agent Orange exposure be given priority consideration for all the screening and diagnostic tools we have at our disposal in the hopes of early detection and treatment of this disease."
Now a banned chemical, Agent Orange is a combination of two synthetic compounds known to be contaminated with the dioxin tetrachlorodibenzo-paradioxin (TCDD) during the manufacturing process. Named for the colour of the barrel in which it was stored, Agent Orange was one of many broad-leaf defoliants used in Vietnam to destroy dense forests in order to better visualize enemy activity.

It is estimated that more than 20 million gallons of the chemicals, also known as "rainbow herbicides," were sprayed between 1962 and 1971, contaminating both ground cover and ground troops. Most of the rainbow herbicide used during this time was Agent Orange. In 1997, the International Agency for Research on Cancer reclassified TCDD as a group 1 carcinogen, a classification that includes arsenic, asbestos and gamma radiation.

The study was funded by the UC Davis Cancer Centre. In addition to Chamie and De Vere White, study authors were Bryan Volpp, associate chief of staff, clinical informatics, VA Northern California Health Care System; Dennis Lee and Joonha Ok, UC Davis resident physicians with the Department of Urology; and Lars Ellison who, at the time the study was conducted, was an assistant professor with UC Davis and chief of urology with the VA Northern California Health Care System. Ellison is now affiliated with the Penobscot Bay Medical Centre in Maine and a major in the U.S. Army Reserve currently serving active duty in Iraq. A copy of the study can be requested by emailing
Amy Molnar at amolnar@wiley.com.

Prostate cancer is the second most common malignancy and the second leading cause of cancer death in American men. It is estimated that there will be about

186,320 new cases of prostate cancer in the United States in 2008 and about 28,660 men will die of the disease this year.
Designated by the National Cancer Institute, UC Davis Cancer Centre is leading the way in identifying the molecular pathogenesis of carcinoma of the prostate, enhancing therapeutic response and identifying chemoprevention. For more information;
Visit: www.ucdmc.ucdavis.edu/cancer.

Such continuing information coming from learned and respected research centers discredit many, if not all the findings of the 1985 Royal Commission on the Use and Effects of Chemical Agents on Australian Personnel in Vietnam. Such a situation calls into question the Government and its relevant Departments commitment to clarify the situation for Australian Vietnam Veterans.

Other Substances

Nor have authorities considered crew member's exposure to a multitude of cancer causing chemicals during their naval career, chemicals such as the following;

a. **Chlorine Black** in Fresh Water Tanks (FW). This was toxic, it effected all involved in FW tank work. You could not remain in the tank with the fumes and were given a break every 20 minutes or so to get some fresh air before returning to the tank. Personnel Protection Equipment (PPE) was not used.

b. **Silverine** in Feed Water tanks. Similar to above although did not appear to be as toxic.

c. **Furnace Fuel Oil (FFO) Vapours.** These were inhaled during long periods in FFO tanks wiping and scraping with poor and sometimes non-existent ventilation during the activity with FFO leaching out of the pores of your skin for days after the activity.

d. **Vapours from Rust Inhibitors and Paint Strippers.** Multiple types used with no PPE when in use.

e. **Vapours from AMORAL** (A chemical used in Flash Evaporators to prevent scaling of steam coils etc.)

f. **Coffee making using steam coils from flash evaporators** . This steam/vapour contained multiple chemicals used to protect steam plant internal surfaces.

g. **Camlem and Turco Cleaners.** Used for general cleaning including yourself when showering after completing dirty work. You would normally find a drum of such chemical in every bathroom during tank cleaning operations. (Especially on HMAS Supply)

h. **Zinc Chromate and Red Lead Paints of various types.** These products were used without even the most basic PPE. They produce chronic health defects, are known as anesthetic and may have other central nervous system defects. Zinc Chromate contains hexavalent chrome, which is carcinogenic.

Sailors used these toxic substances without approved respirator types or suitable/sufficient ventilation appropriate for this type of work. Zinc Chromate was used as a ‘primer coat’ in the painting of tanks and other ship’s metal structures in the machinery spaces and bilges. Sailors were regularly exposed to the dangers of zinc chromate when sanding, grinding, cutting and welding areas where zinc chromate had been previously applied.
The pigment particles generated when sanding or grinding Zinc Chromate releases carcinogens into the atmosphere. When heated by cutting or welding these carcinogens can be released as a fume where the risk is compounded due to the extra volatility of the fumes generated.
Hexavalent chromium enters the body in two ways: by being inhaled or by being swallowed. Chromium can be inhaled when chromium dust, mist, or fumes are in the air. Chromium dust can also get on cigarettes. If contaminated cigarettes are smoked, the smoker inhales additional chromium along with the tobacco smoke. But until smoking was banned internally on RAN Warships sailors were regularly exposed to secondary smoke in Mess Decks, Cabins, Cafeterias and Wardrooms and whilst ‘On Watch’.

Zinc chromate is listed as a category 1 carcinogen and was in common use in the RAN until 1991. The National Occupational and Safety Commission (NOHSC) determined that there is sufficient evidence to establish a casual association between human exposure to these substances and the development of cancer.

i. **Salt Tablets.** All workers in hot spaces were directed to take at least eight of these large salt tablets every four-hour watch. However, when the relevant medical directions are reviewed, one finds conflicting information.

BR 888 (dated 1959)

Page 118 - talks about treating 'Stoker's Cramp' with a mixture of 1/2 teaspoon of salt in a pint of cold water.

To prevent 'Stoker's Cramp’ - ratings keeping watch below are to regularly drink the same mixture before going on watch. If no ordinary table salt or salt tabs are available then you are to use 'one part of clean sea water in ten of ship's drinking water'.

Page 302 - Medicines supplied for use in HM Ships

Sodium chloride tabs 0.5 gm or 71/2 gr, enteric coated, white or chocolate coated tabs, for tropical issue and are to be used in the treatment of heat exhaustion and 'stoker's cramp'.

Interesting though, in ABR 1991, Vol 2, Chapter 74 (published late 70's early 80's): Naval Aviation Medicine

Under Thermal Stress, para 7410 states –

'Very little extra salt needs to be taken in hot climates as our normal daily salt intake is usually far more than we need...Salt tablets should never be taken as they can give a very dangerous overload of salt. Compared to this situation the consumption of extra water is not dangerous and is in fact beneficial.'

Those two regulations are in fact at odds with each other.

j. **Silver Nitrate.** Silver Nitrate was used during the production of fresh water from seawater to test for the presence of salt. The presence of iodide can be tested by silver nitrate solution. Samples are initially acidifed with dilute nitric acid to remove interfering sulphite ions. This step avoids confusion of silver sulphide or silver carbonate precipitates with that of silver halides. Addition of $AgNO_3$ to the resulting solutions produces a precipitate in the presence of halides. The color of precipitate allows the identification of the halide: colorless, pale yellow, yellow. AgCl(s) and AgBr(s) turns grey (solid silver formed) uponphotochemical decomposition, with a faster rate on AgCl(s). As with all silver salts, silver nitrate is toxic. Sailors used the solution provided to 'burn off' warts and other skin imperfections and if the Silver Nitrate solution did not show the presence of salt in the water, they would drink the test tube of water for taste for human consumption.

The MSDS for Silver Nitrate is noted as being in the crystal/powered form; however, toxicity is still present even if dissolved in water as it was for use in the RAN.

The qualitative test for chloride content of feed water is described in some detail in BR3001 Chapter 12 Article 1209. The use of Citric Acid for distilling plant feed water treatment is described in BR3001 Chapter 21 Article 2120.

k. **Shell Toluene.** Used, amongst other things to clean off rubber cables prior to packing with a 2 part epoxy mix to form a hull gland on the sonar cable going through the pressure hull on the Oberon's The Toluene was a 2 part mix and carcinogenic.

Discussion

British Regulations (BRs) were used extensively in the RAN during the 1960s and 70s, and over time were totally rewritten, modified or accepted in total as Australian Books of Reference (ABRs). Sailors were held accountable against these regulations (rules?) for their implementation and compliance.

The methods employed to clean ship's tanks as described above were in accordance with these regulations.

The 'cocktail' of carcinogenic and dangerous solvents represented in the paragraphs above were used with little, if any positive control over exposure rates or protective equipment. From the simple matter of no hearing protection in machinery spaces to the inappropriate and unfettered use of carcinogenic and dangerous solvents as personal cleaning agents freely available in the shower and washing facilities onboard ships and their general acceptance as a general cleaning agent onboard ship. The somewhat haphazard and uncontrolled use of these chemicals, many acknowledged as carcinogenic and dangerous solvents used without PPE placed sailors at an unacceptable level of risk that has resulted in this current situation and may explain many of the conditions Naval Veterans are now experiencing.

The Enclosures

The Enclosures accompanying this brief were sourced from a number of sites including Government Sites such as the Australian Safety and Compensation Council, which has a Hazardous Substances Information System. The Global Chemical Pollution Website based in Australia. The Royal Australian Navy News that has a public circulation and web site. The Material Safety Data Sheets are reproduced from relevant company web sites. The signal also in the Enclosures was retrieved from a "Sailors Web Site" situated in Australia as were a number of other details and references within BRs.

Conclusion

Every RAN ship held copies of the relevant BRs and other associated documentation regarding the cleaning of tanks. What they did not hold was the equipment or testing procedures to allow adherence to such standards as Exposure Limits nor did they hold copies of the relevant MSDS. The time personnel spent in the tanks was arbitrary if controlled at all. The testing of the environment within the tank was to ascertain if the environment was explosive, not if it supported life, or the time one could remain in a tank without adverse effects. It is a fact that many personnel served on a range of ships with some individuals being on a number of these ships exposed and re-exposed time and time again over the course of their time in each ship.

Consider HMAS Sydney, the Daring Class Destroyers and the Leander Class Frigates and HMAS Supply. All crew were exposed to a range of these chemicals. This exposure to a range of ‘proven carcinogenic’ chemicals including asbestos and agent orange, some in concentrated form will have had an accumulative and negative effect on their health. You may wish to consider the effects of this range of chemicals on a single person over the course of a number of years in the RAN. The accumulative effects of exposure over months and years to a range of chemicals cannot be explained away

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Enclosures:

A. Feature Article - NAVY NEWS Vol 49, No 2 dated February 23, 2006

B. Gamlen Solvent 260 – Surechem Industries MSDS (Noted on MSDS as Hazardous According to Criteria of Worksafe Australia)

C. Zinc Chromate Primer – Klinger Paints MSDS

D. Zinc Chromate – Randolph MSDS

E. Silver Nitrate -ProSciTech MSDS (Noted on MSDS as Hazardous According to Criteria of Worksafe Australia)

F. Gamosol (Noted on MSDS as Hazardous According to Criteria of the National Occupational Health and Safety Commission, NOHSC)
Note: The ASCC succeeded NOHSC on 7 February 2005. The first meeting of the ASCC was held on October 20, 2005 and previous MSDS were upheld and continued.

G. RAN Signal DGNAVCERTSAFE 142313Z SEP 04 SIC Z4P/W2M/HFH