1. BASIC SAFETY

Department of Conservation & Land Management

FIRE FIGHTING PERSONNEL

TRAINING MANUAL

Adapted by CALM Fire Protection Branch from Bush Fire Training Modules developed by BUSH FIRE COUNCIL OF N.S.W.

CONTENTS

1. BASIC SAFETY

SAFETY in any occupation is a major consideration. In bush fire fighting it is 'the' consideration. You will face many potentially dangerous situations as a fire fighter and your life, that of your fellow fire fighters, may well depend upon your ability to react in a safe, calm manner. The purpose of this chapter is to acquaint you with basic safety procedures and to help you to be a safe fire fighter at all times.

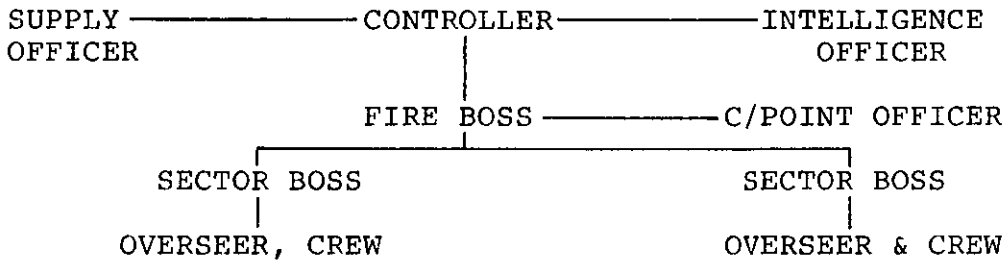
1. YOU AND YOUR CREW

The first point to consider is the organisation of the crew. The fire crew is a group of individuals formed together in a common cause - the protection of life and property from bush fires. Such a group can only operate as a team by observing a discipline and respecting lines of authority. The field officer or overseer is the field leader of the crew and carries full responsibilities for fire fighting efficiency of the crew in the field.

The officer or overseer must have the full support of crew members, and should be obeyed by every member of the fire crew. Remember, the officer through liaison with the fire boss is the most informed person in terms of the total fire situation. A safe fire crew is one in which every member is competent at their allotted task and co-operates as a member

of a team, respecting the authority of the officer or overseer in charge.

TYPICAL DEPARTMENT LARGE FIRE ORGANISATION



2. SAFETY IN NUMBERS

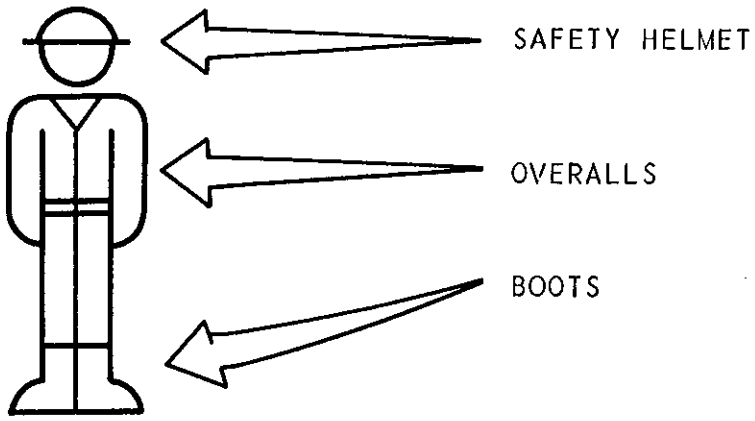
An old saying but very true. Always work in a team at the fire front, so that you are able to summon help immediately if you are injured. If you are required to leave the group and carry out duties on your own, make sure that a responsible person knows where you are going and what you are doing. If possible, give an estimated time in which you expect to complete your task.

Different crews have different procedures for members carrying out tasks on their own - make sure you are familiar with yours. Above all do not assume that everything will be alright. Injuries happen at the most unexpected time and the sooner you receive help the better.

Never work alone at the fire front. This is the most dangerous situation you will be in so you must work with one other at least.

3. YOUR CLOTHING

The Department encourages the use of standard clothing, this includes: safety helmet, heavy woollen or cotton trousers (full length), heavy woollen or cotton shirt (long sleeve), heavy safety boots in good condition.



You may have such clothing issued, or you may be required to supply your own. Either way it is important to understand the value of each item.

3.1 Safety Helmet

A safety helmet is compulsory headgear for Departmental members when carrying out any function in the field or in any situation where there is a danger from falling objects.

The danger is greatest in a forest fire, but there is always a possibility of injury from objects striking your head.

Make sure that the inner frame is adjusted to suit you and that the chin strap is in place. Do not take chances with head injuries. Helmets also serve as a means of identifying people with various levels of responsibility. You should be familiar with the adopted code.

3.2 Shirts and Trousers

The most desirable clothing is long trousers made of wool or cotton with a long sleeve shirt also of wool or cotton. Do not wear synthetic fabrics as these burn readily and melt to the skin. Make sure that when approaching a fire, your shirt is buttoned up, your sleeves rolled down and where practical, your trousers are secured at the ankles. Radiated heat is the most dangerous effect of a bush fire and you must protect your body from it.

3.3 Boots

You will be walking on hot ash and burning materials. Wear solid boots (safety type preferably) with thick soles which will protect your feet.

3.4 Socks

Socks should be thick, long and made of wool or cotton. Again, do not wear synthetic fabrics.

3.5 Gloves

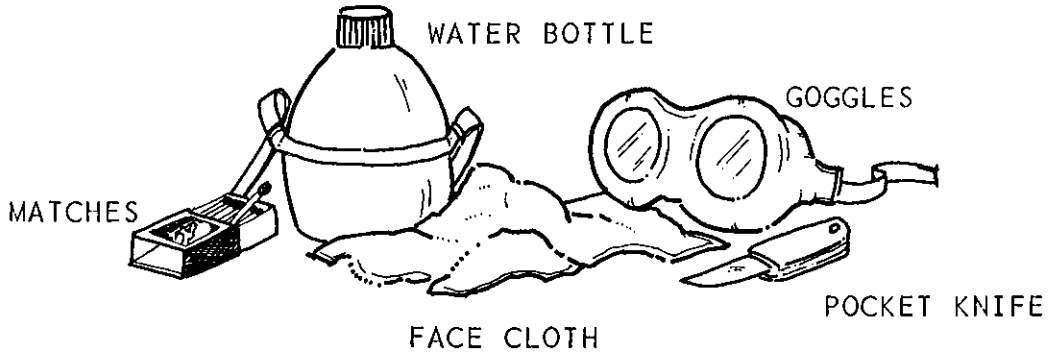
Do not be embarrassed to wear gloves. Hand tools are hard on your hands and burns can be avoided when moving larger burning material.

3.6 Goggles

Goggles are essential when working on a fire edge to prevent smoke irritation and for preventing hot ash or foreign bodies from lodging in the eyes.

4. PERSONAL ACCESSORIES

A pocket or sheath knife can be useful when making temporary repairs to equipment. Matches should be carried for safety. You may be forced to burn an area to prevent a 'hop over' or to burn an area for your own safety.

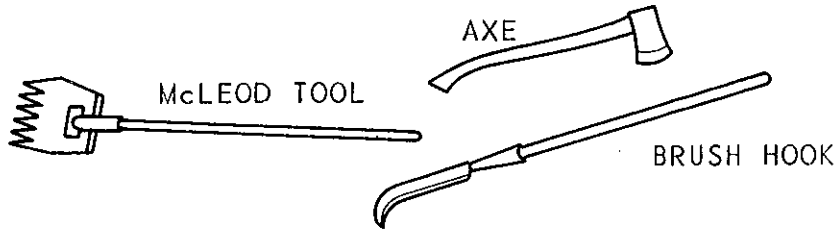


Fire suppression is a demanding task. Prolonged periods without water will reduce your performance and put you at risk: ensure that you have an adequate supply of clean water. Drink more than you feel you need to avoid the effects of heat stress and dehydration.

5. KNOW YOUR EQUIPMENT

Bush fires cause tremendous destruction and are powerful forces of nature. We require effective tools to combat these forces, but these tools can be dangerous if not used correctly.

Firstly, let us look at hand tools. There are three basic hand tools used in fire protection (axe, slasher, and rakeho), each with a specialised use, each with a sharpened blade. There are two basic safety precautions.



5.1 Safety Precautions

Make sure that all sharp edges are covered or protected whenever tools are stowed or carried. This is not only a safety precaution but is good fire protection practice as blunt tools are virtually useless.

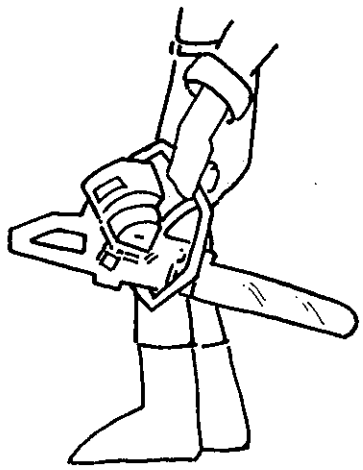
Stand clear of persons using sharp tools, remembering at all times that a person will be swinging the tool through an arc. Have the same respect for others, check that you have a clear area in which to swing your axe, slasher, rakeho. When receiving instructions on the use of hand tools, you will be shown several ways of working safely as a group. Learn these methods and use them at all times. Carry sharp tools firmly in your hand with the handle parallel to the ground and sharp edge away from you. If you wish to pass close to a person using a hand tool, give warning so that he knows you are there.

5.2 The Chain Saw

The chain saw is probably the most potentially dangerous piece of equipment used by bush fire fighters. Using the chain saw is a task for the specialist but you may be required to carry a saw, in which case observe the following:

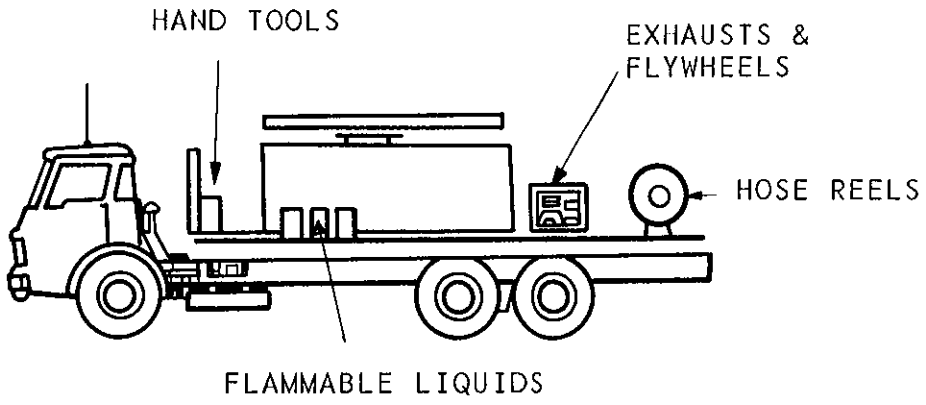
(a) Make sure there is a suitable cover on the blade.

(b) Carry the saw as shown in the following diagram. Chain saw cutters are very sharp so keep the blade away from the body in case you slip and fall. Be constantly on the look out whenever a chain saw is in use near you. These tools cut very quickly and you could be caught if the operator is not aware of your presence.



5.3 Vehicle Safety

We all realize the dangers associated with vehicles, but in a crisis situation, you may overlook basic safety principles if you are not constantly alert. Be familiar with your vehicles. Look for possible hazards so that avoiding them becomes a habit. You may have new equipment fitted with all the recommended guards, or you may have older equipment. Either way, take time to look closely for possible hazards. The following diagram shows hazards which may be present on a vehicle.



The other important aspect of working with vehicles is the way in which you board and alight from them. There is always a sense of urgency at a fire, and certainly, the sooner the fire is attacked the better. Remember though - a fire fighter with a twisted ankle or a fire fighter who has jumped onto a sharp object is a hindrance, not a help. Take that little extra time to be sure of yourself when boarding or alighting from vehicles. Your tanker may be the shadiest place around but, if given a rest break, do not choose the back wheels as a place to sleep. The tanker may be required at a moments notice and you could be seriously injured.

6. OVERHEAD POWER LINES

There is one simple rule when working near overhead power lines - KEEP CLEAR. Always assume that broken power lines are "alive". The electricity supply authorities have special equipment to disconnect power from faulty lines, but this equipment cannot cover all situations and may not cut off the power as intended. Keep clear until the supply authority advises that the power has been disconnected.

Do not aim water at broken or sagging power lines. Sagging or broken lines may be close enough for the electric current to flow through the water jet to the operator. Remember - many overhead lines operate on very high voltage.

If possible, station a crew member near damaged or broken lines so he can warn people of the danger.

8. SURVIVAL

A fire fighting gang is a team working for a common cause and there are many people in it with years of experience. For all that, fires are dangerous and you must never underestimate the situation. Be on your guard for the two major hazards which could affect you.

8.1 Radiated Heat

The intense heat radiated from a fire can be a killer. Much of this heat can be stopped, however, by dressing sensibly. Rolled up sleeves may be more comfortable but they expose you to the very real danger of radiated heat.

8.2 Heat Exhaustion

This can come upon you very quickly. We all have limitations - Know Yours! Drink water (not iced) at a sensible, constant rate and if exposed for prolonged periods, make sure you have some food. If you begin to feel faint, tell someone, and move back from the fire front. Remember the difficulties in predicting fire behaviour and, at times, consider the possibility of emergency withdrawal. How would you get out of your present situation in an emergency?

8.3 Survival Tactics

Are there any safe refuges nearby? Train yourself to ask such questions at all times and you should avoid the situation whereby you are threatened directly by the fire. But, fires are unpredictable.

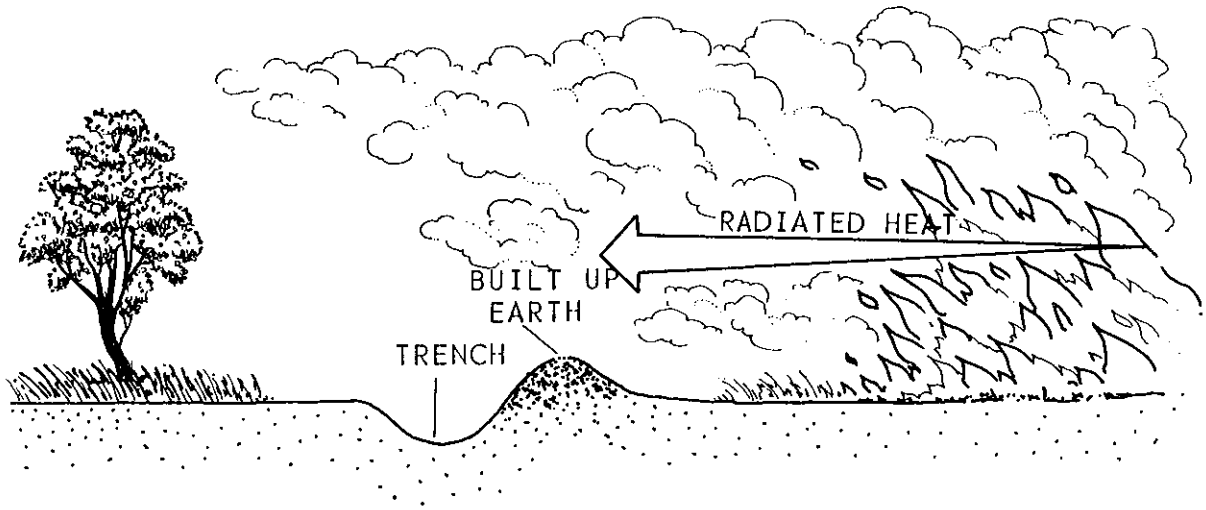
If suddenly threatened by fire - don't panic. There are two aspects of fire behaviour which are very much in your favour.

(a) Heat rises so the air at ground level is cooler than a metre or so above the ground.

(b) The fire is constantly moving and the intense heat associated with the fire front will normally pass quickly.

To Protect Yourself

Scrape a shallow refuge (the deeper the better) and lie face down. Remember the caution on radiated heat. Cover yourself as much as possible so as to protect yourself from this heat. See diagram below.



These notes are intended to make you a safer fire fighter. Think Safety at all times. Your training officer will have given you practical instructions on the points raised in these notes, but there may still be some questions in your mind - Ask!

Ensure that you

Are informed

Act safely

Act as a team

9. SUMMARY

"WATCH OUT" ON THE FIRE LINE

The following eight commandments for fire fighting crews must be memorized for your own safety and that of your workmates.

WATCH OUT

W-WEATHER affects fire behaviour, so watch for changes in wind strength and direction.

A-ACTIONS must be based on current and expected fire behaviour.

T-TAKE CARE by conserving energy and avoiding dehydration. Drink water frequently, even if you don't feel like it.

C-CONTACT to be kept at all times with your leader(s) and workmates.

H-HAZARDS to watch for are flashy or heavy fuels, dense thickets, steep slopes and burning trees.

O-OBSERVE marked changes in fire behaviour, and suitable escape routes.

U-UNDERSTAND your instructions and make sure yours are understood.

T-THINK clearly, remain alert and act decisively.

2. FIRE BEHAVIOUR

2. FIRE BEHAVIOUR

1. FIRE: A GOOD FRIEND - A BAD ENEMY

We are all familiar with fire and the damage which fire can cause. The task of the fire fighting organisation is to minimise the damage caused by fires and it is only by having a basic understanding of fire behaviour that we can have the upper hand.

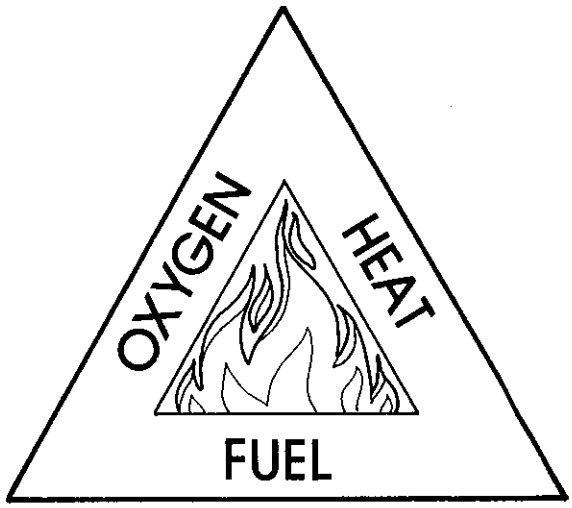
The major problem in fighting bush fires is the difficulty of predicting the behaviour of the fire. We appear to have it contained one moment and then it will suddenly change direction, and, we lose control. For all that, fire does behave according to certain rules and we must understand these rules if we are to be effective fire fighters. Let us look, firstly, at the three factors required to keep a fire going.

2. THE FIRE TRIANGLE

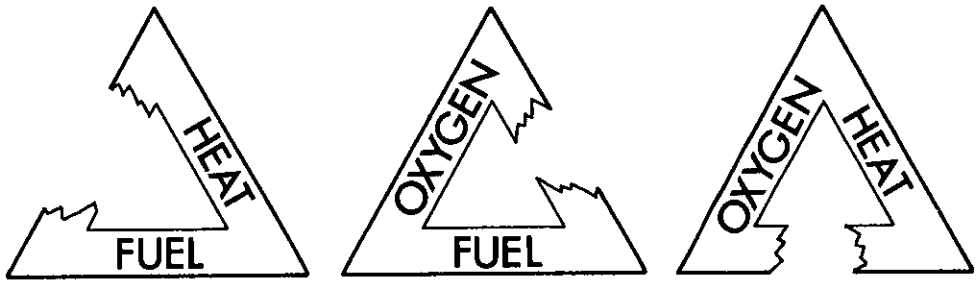
Any fire requires three elements before it can keep itself going:

FUEL • HEAT • OXYGEN

We can, in fact, draw these in the shape of a triangle so that we can see how they rely on each other.



All three factors must be present if we are to have a fire. The three diagrams below show the triangle with one side broken. In each case, the fire will go OUT.



Knowing this triangle gives us three ways of attacking a fire, that is -

(a) remove the fuel

(b) remove the oxygen (in most cases the surrounding air)

(c) cool the fire.

3. REMOVE THE FUEL

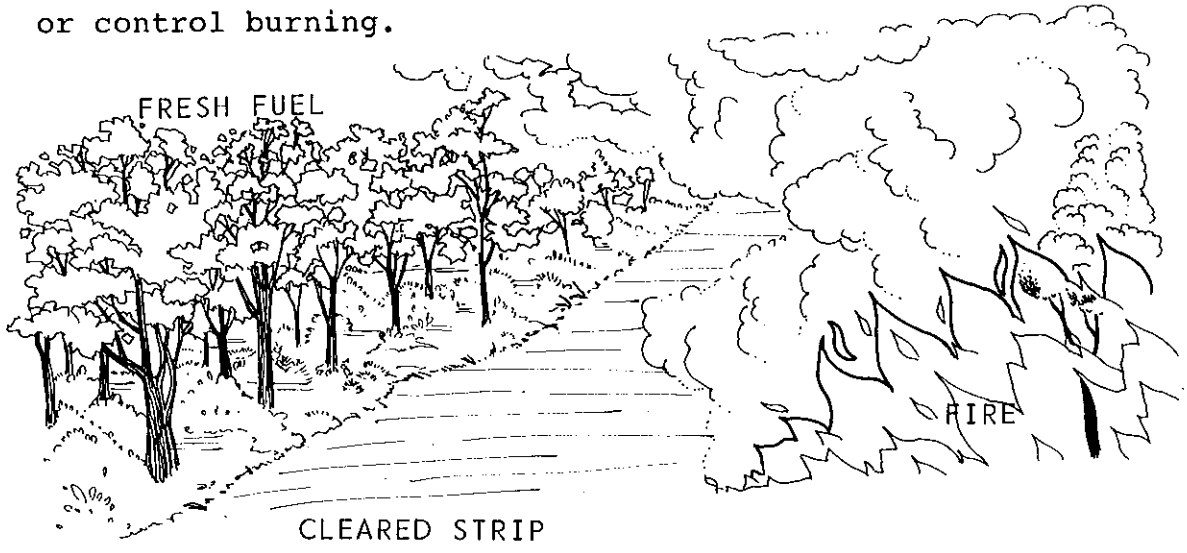
Removing the fuel is the most effective means of stopping large fires and, more importantly, the best way of ensuring that large fires do not happen. When stopping fires, we can, for example:

(a) rake a trail which the fire cannot cross

(b) use earth moving machinery to clear large areas

(c) burn selected areas (back burning).

To reduce the probability of large fires, we use each of these tactics to reduce the volume of fuel before the start of the fire season. The practice of burning selected areas is known as hazard reduction by prescribed burning and is the most important weapon we have against the occurrence and spread of large fires. In this case, burning selected areas is not called back burning, but is referred to as prescribed or control burning.



4. REMOVE THE OXYGEN

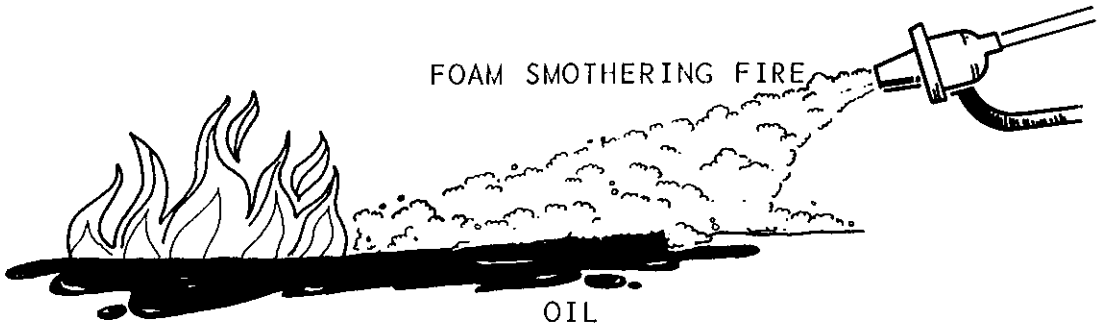
Removing the oxygen, by starving the fire or air, is rather difficult with large bush fires. This attack is used to fight localised fires and can be very effective. Let us look at a few examples:

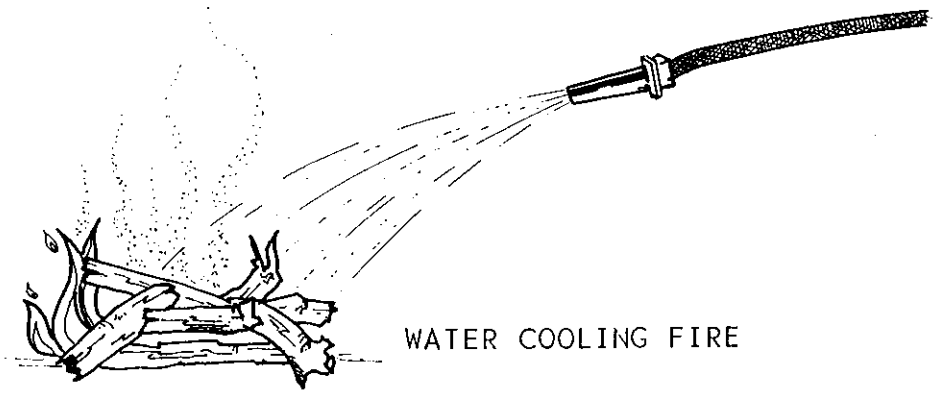
(a) A beater - or branch of a tree blankets the fire and so starves it of air. Note that a beater also breaks up the fuel and so removes such fuel from the heat of the fire.

(b) A safe and effective method of helping a person whose clothing is on fire is to either roll them on the ground or wrap them in a blanket. The purpose of this is to cut off the oxygen.

(c) Shovelling dirt on a fire.

(d) Laying foam onto burning liquid material such as oil.





WATER COOLING FIRE

5. COOL THE FIRE

Cooling a fire is the most common method of attack. When we spray a fire with water we are, in effect, cooling it. The water may, in addition, smother the fire and we can even break up the fuel with a strong jet. But, the primary purpose of water when fighting bushfires is to cool the fuel to the point where it will no longer support combustion.

6. HOW HEAT IS TRANSFERRED

There are three ways in which heat can be transferred:

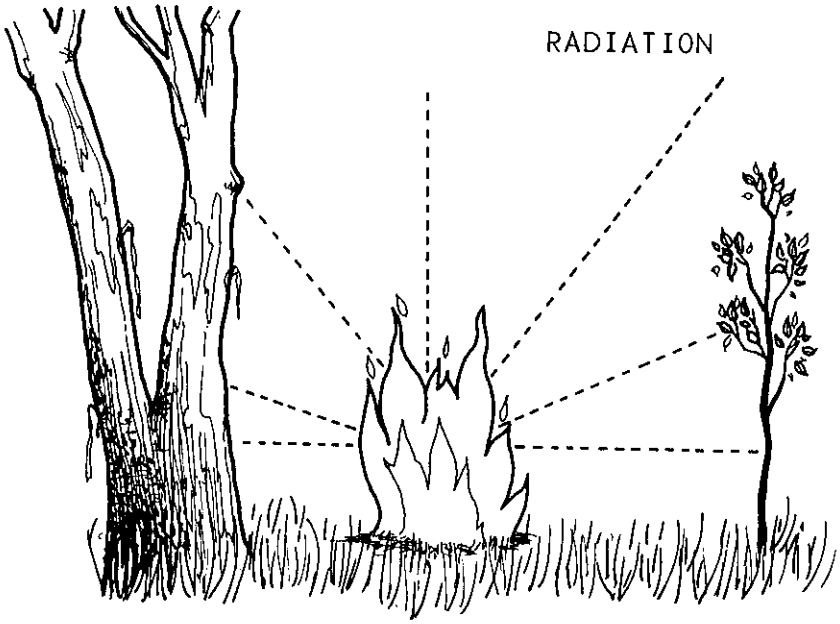
(a) radiation

(b) convection

(c) conduction

Radiation

This is the process by which heat energy is transferred from its source to an object; that is, it is the direct heat we feel from a fire. Radiant heat is the heat which will directly act upon fuel immediately before the fire front and bring it to the point where it will burn. Obviously, the hotter a fire, the greater the amount of radiant heat, and, the faster the fire will spread.



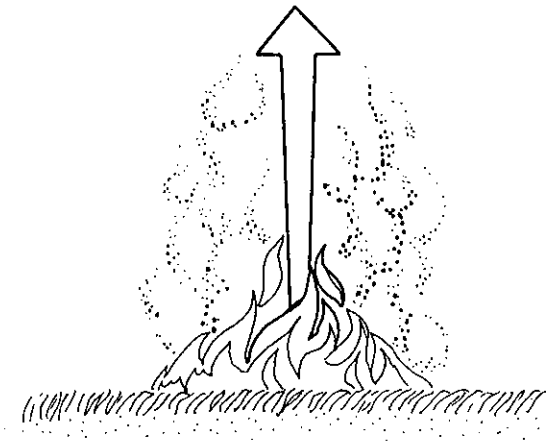
Convection

Hot air is lighter than cold air and so it will rise. As it rises, it will carry heat with it and gradually lose it to the surrounding atmosphere. This means that, as a fire grows in strength, there will be an increasing volume of air which will become heated and rise - replacement air being drawn into the fire at ground level. This has several important implications for fire fighters:

(a) A fire will supply its own oxygen by continually drawing in a supply of fresh air.

(b) Very large fires can create strong winds which may, in turn, alter the behaviour of the fire.

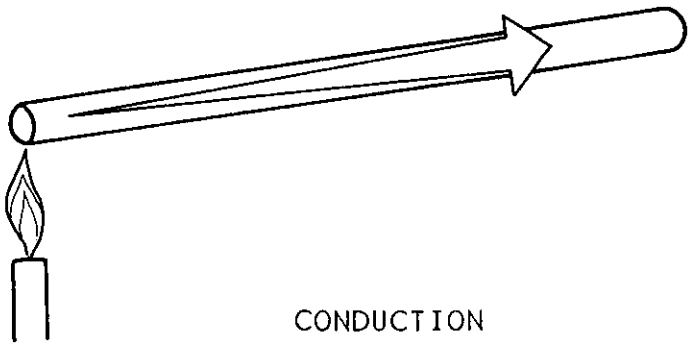
(c) The hot air rising from a fire often carries pieces of burning fuel which may then be carried forward in front of the fire and cause small fires to start well in front of the main fire. This is called 'spotting' and occurs in dangerous fire situations.



CONVECTION

Conduction

This form of heat travel is not a major problem in bush fires as the word is used to describe the process where fire travels by heating material immediately next to the source of the heat. For example, heat moving up an iron bar. It is common practice to check the temperature of haystacks by inserting an iron bar and then feeling the bar after a given time.



CONDUCTION

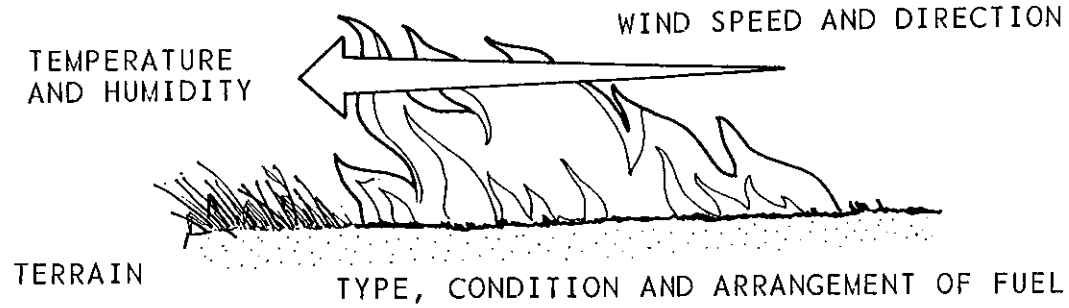
7. HOW FIRE TRAVELS

Now let us look at the factors which affect how a fire will behave. There are three major factors. These are:

Fuel characteristics

Weather Factors

Topographic Characteristics

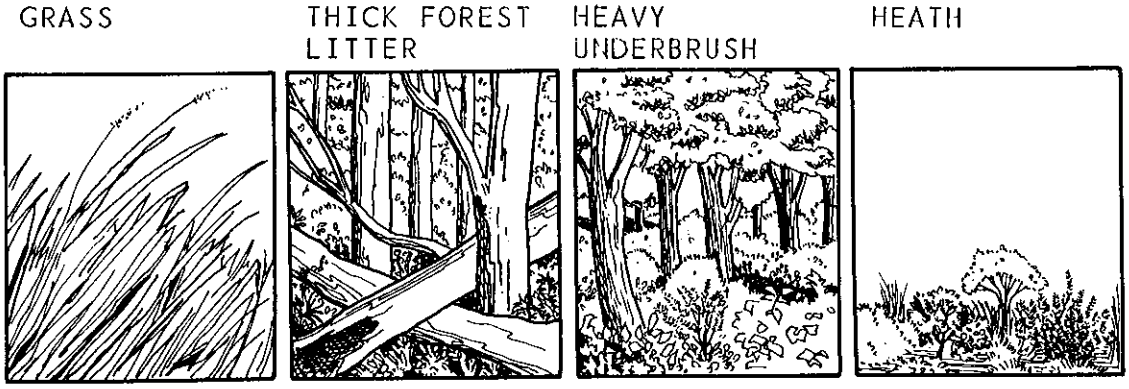


We will look at each in detail.

7.1 Fuel Characteristics

There are four different aspects of fuel which affect the behaviour of a bushfire.

(a) Fuel type. Most material will burn given the right conditions, however, they will burn with different degrees of intensity. Fuels can normally be divided into the following groups.



Natural variability in the chemical and physical make-up within each of these fuel categories causes differences in their combustion and fire behaviour characteristics.

(b) Fuel moisture content. This is simply the amount of water in a fuel. Obviously the more moisture a fuel contains the more heat is required to ignite it. Thus moisture content directly affects ease of ignition, the fire intensity and spread rates.

(c) Fuel quantity or volume. The more fuel there is to burn, the more intense the fire will be and the more rapidly it will spread. Doubling the amount of available fuel can increase fire intensity four fold.

(d) Fuel size, arrangement and continuity. Small or fine fuels ignite more quickly, and fires spread more rapidly and burn out faster than they do in coarse fuels.

If fuels are arranged loosely, like grass or scrub, fires spread rapidly. If fuels are compacted, like pine needles, fires spread more slowly.

Continuity of fuels, or how close they are to one another, is important in the vertical directions. If there is a large separation between ground fuels and the crowns of the trees, the possibility of a fire climbing to the tree tops (crowning) is much less.

7.2 Weather Characteristics

There are four major weather factors that affect how a fire will behave. They are:

Temperature
Relative Humidity
Wind Speed and Direction
Atmosphere Stability

(a) Temperature

There is a greater probability of fires starting - or of on-going fires reaching blow-up conditions - when the temperature is high. A high temperature simply means that the fuel is closer to its burning point and so will more readily ignite. Once ignited, preheated fuels will burn more rapidly than cold fuels.

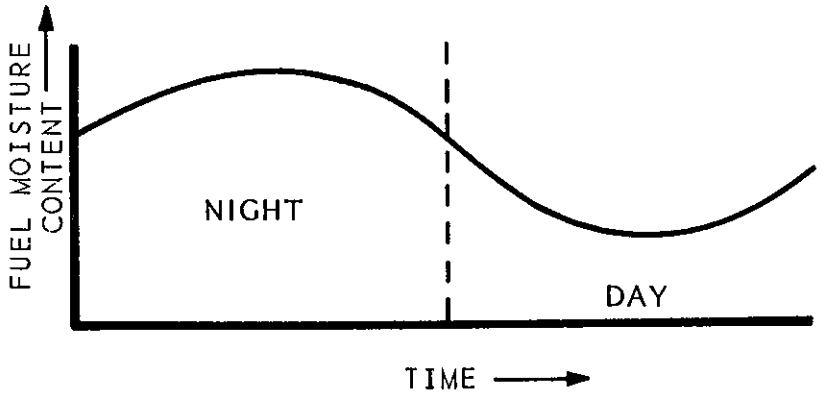
(b) Relative Humidity

Air is like a sponge in its ability to hold moisture. This is expressed in percent and is the amount of moisture present in a parcel of air compared to the amount it could hold at that temperature. Warm air can hold more moisture than cold air.

When the air is saturated, rain or dew forms and fuel moisture is also high. When the air is say only 1/4 saturated (25 percent R.H.) it is relatively dry and tends to draw moisture from the fuel and from the plants and the ground. On very dry days the fuel and the plants give up moisture to the atmosphere and so become more flammable.

As a result of this dependency on temperature and relative humidity the fire will normally quieten during the night and be fiercest in the early

afternoon. Beware of warm, dry nights when humidity is low, as the usual lull in fire behaviour may not occur.



(c) Wind

Of all the factors that govern fire behaviour, wind has the greatest influence on the rate and direction of spread.

Wind speed has two important effects on bushfire:

(a) Wind will drive a fire forward by actually blowing the flames over and towards fresh fuel and bringing this fuel to combustion point more rapidly.

(b) Wind forces a continuous supply of fresh air (hence oxygen) into a fire and so increases the intensity. Large fires may cause their own wind as described later.

The most dangerous aspect of wind is the unpredictable nature of wind patterns which can cause a fire to change direction in an instant. Remember that winds are caused by changes in atmospheric pressure and temperature and the forces which create a wind are complex. When suppressing a fire always give yourself a safety margin in case the fire changes direction without warning.

Wind assists spotting by carrying burning material beyond the fire.

(d) Atmospheric Stability

Wind is also associated with the fourth weather factor, atmospheric stability. An unstable atmosphere is normally indicated by thunderstorm (cumulus clouds). These are usually associated with strong gusty winds, which may cause sudden changes to the direction and rate of fire spread.

7.3 Topographic Characteristics

There are two important elements of topography

- slope - how steep it is
- aspect - the direction it faces

The steeper the slope, the faster a fire will move up it. This is because:

- flames moving uphill are closer to the fuels. The fuels are preheated by flame radiation.

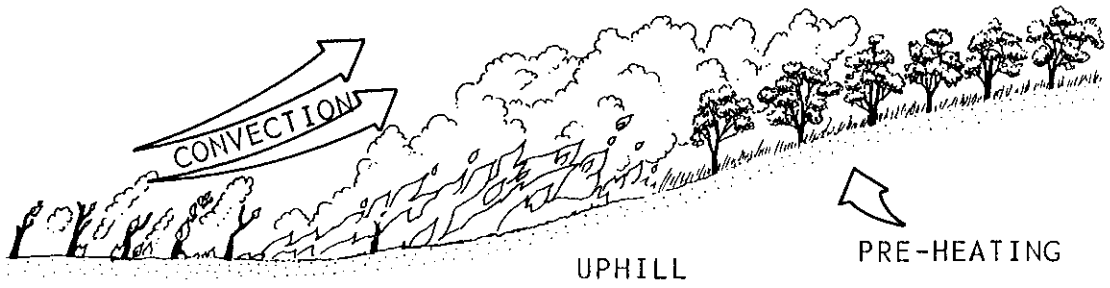
- wind currents are normally uphill and this tends to push the heat and flames into new fuel.

The spread rate of a fire is doubled on a 10 degree slope and increased four times on a 20 degree slope, compared to level ground. This also means that a fire burns correspondingly slower when travelling down slope.

Aspect is an important topographic element. North facing slopes receive more direct radiation from the sun, which means normally there will be higher temperatures, lower humidities, and lower fuel moisture than on southern aspects, with corresponding higher fire intensities.

The effect of slope and aspect can be quite complex as the terrain will have a bearing on the pattern of the local winds. Winds can be affected by narrow gullies, ridges and tall or dense vegetation. Also the local heating and cooling of the earth's surface during the

day and night strongly influences wind direction and spread. This local knowledge of wind behaviour is important in safe and effective fire fighting.



8. TYPES OF FIRES

Large bush fires are normally complex in the way in which they burn, but we can identify three basic fire types and, from these, we can understand the nature of any fire. The three basic types are:

(a) Ground fire

(b) Surface fire

(c) Crown fire.

8.1 Ground Fires

These are not common as they require that fuels such as peat, or thick layers of humus, be present. Such fires burn slowly and can be a problem simply because they may burn unnoticed. Individual smouldering logs and tree roots are a more likely problem for the average

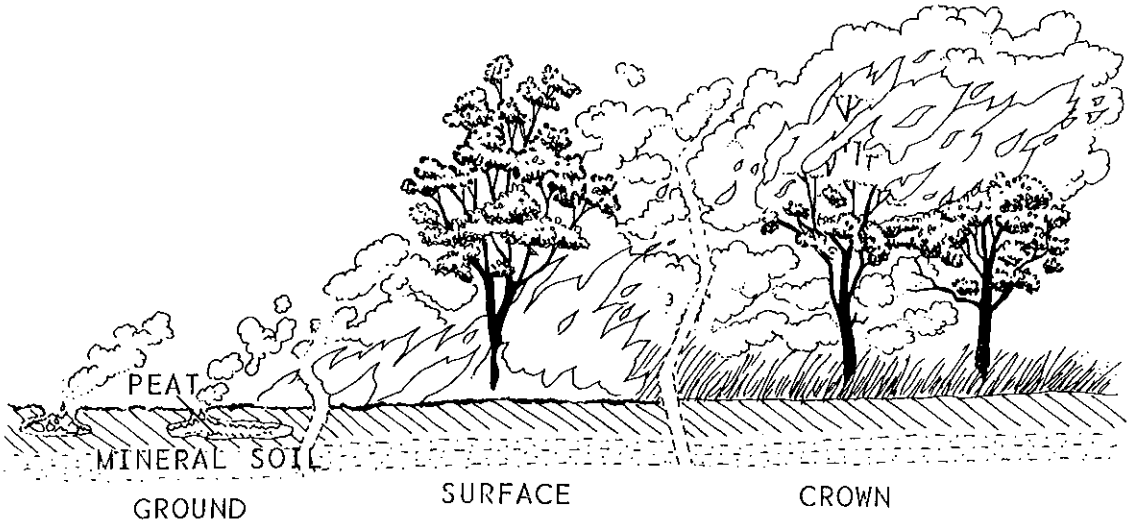
fire fighter. Smouldering sawdust heaps can be a real headache.

8.2 Surface Fires

These are by far the most common type of fire and here we are referring to grass fires, or, fire burning through surface fuel in a forest.

8.3 Crown Fires

These are a "second stage" fire encountered in forests. A crown fire occurs where a surface fire becomes so intense that the rising heat ignites the tree tops and the wind carries the fire along through the upper storey vegetation. Such fires have to be supported by a strong surface fire. Crown fires cannot occur if there is insufficient ground fuels to promote an intense surface fire and subsequent crown fire.



9. BLOW-UP FIRES

Fire fighters must learn to recognize the danger signs that spell potential trouble from erratic fire behaviour on blow-up fires. Experienced fire fighters expect fires burning under heavy fuel and severe weather conditions to display intense fire behaviour. The dangers of such fires may be obvious. However, it is often small fires burning under seemingly mild conditions which, for no apparent reason, escalate, and endanger the lives of fire fighters.

9.1 What to Look Out for

Whilst forecasting provides an overall indication of the fire weather conditions, it is the personal responsibility of every fire fighter to continually observe weather conditions at the site of the fire. Fire fighters must be trained to anticipate wind shifts due to local influences such as terrain, vegetation, sea-breeze or land breeze etc. Changes in fire behaviour can be sudden due to changes in fuel types, wind behaviour and other weather factors.

Fires are most likely to blow-up when fuels are dry (below 6 percent) on days of high temperature, and low relative humidity. Exposed areas, flats, creeks and heavy fuel accumulations are places where fires are likely to behave erratically and violently.

Fire fighters should learn to position themselves so that they are not threatened by sudden changes in fire behaviour. They should avoid being caught between the headfire and a series of seemingly harmless spot fires downward from the main fire. The interaction of these fires often leads to violent fire behaviour.

REMEMBER - although fires may appear unpredictable, fire does behave according to a few simple laws. Knowing these laws makes every fire fighter a person who can sensibly predict the movement of a bush fire.

3. HAND TOOLS AND KNAPSACK SPRAYS

3. HAND TOOLS AND KNAPSACK SPRAYS

In this module we consider:

(a) Care, maintenance, and use of knapsack sprays.

(b) Maintenance and sharpening of hand tools.

(c) The principles of constructing fire trails with hand tools.

1. THE KNAPSACK SPRAY

The simple knapsack is the single most important item of equipment for "wet" fire fighting, and yet, it may be the most neglected item.

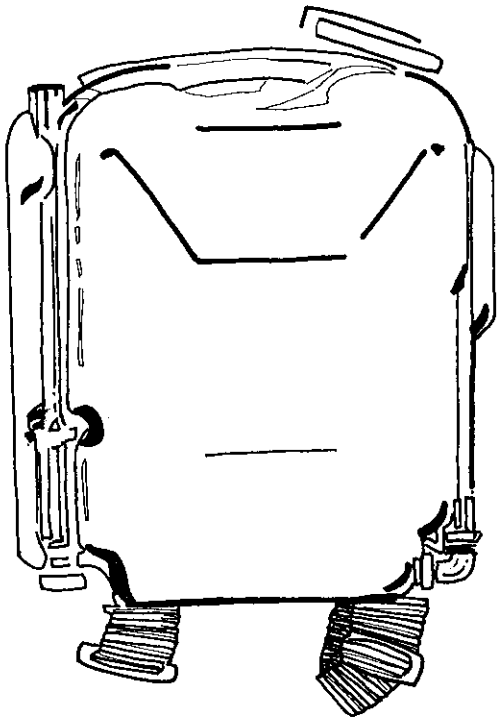
The manufacturers have offered the following technical details and advice on maintenance.

1.1 Technical Details:

The high density polythene container (with U.V. inhibitor) has a moulded recess to hold the pump and hose when not in use. It also features an inbuilt carrying handle, adjustable terylene straps with shoulder supports and a large filler neck for quick and easy filling.

The outlet elbow swivels for operator convenience and has a "snap-in" fitting for easy hose and pump removal without the need for special tools.

The high pressure double-action underarm pump is all brass and fitted with a fully adjustable nozzle which offers either a straight jet or variable fan spray.



1.2 Care and Maintenance:

With all equipment of this type, the two major problems which can occur are lack of lubrication on the working parts, and cleaning out of the units after use. From experience it has been found that after knapsack sprays have been used, operators are inclined to return them to stock or storage without proper maintenance. When

they are needed again in an emergency, the component parts have dried out or seized. Lubrication of the pump plungers, plus cleaning out of the valves and other components after use, will result in continued efficient operation.

Unscrew the gland nut on the pump plunger and remove and wash out the plunger in clean water. Renew any worn or damaged parts and then smear both the gland and the plunger "O" rings with petroleum jelly. At the same time lubricate the plunger tube.

Next, check the elbow valved tail and ensure that the ball in the valve is clean and moves freely.

To ensure easy operation, apply petroleum jelly occasionally, as the components can lock if left in a disused state, resulting in difficulty in adjusting, even though made of brass.

Check the strainer inside the container thoroughly before use to ensure that it is clean. A blocked strainer, which could result from using impure water, can cause loss of pressure.

Do not store the knapsack in sunlight as this will deteriorate the plastic container. Always return the

pump and hose to the correct position on the container. The container is made of plastic and should be handled with care. To protect and maintain the outward appearance of the plastic, use "Armorall" solution.

Ensure that the straps are kept clean and do not become frayed or rotted.

1.3 Correct Usage:

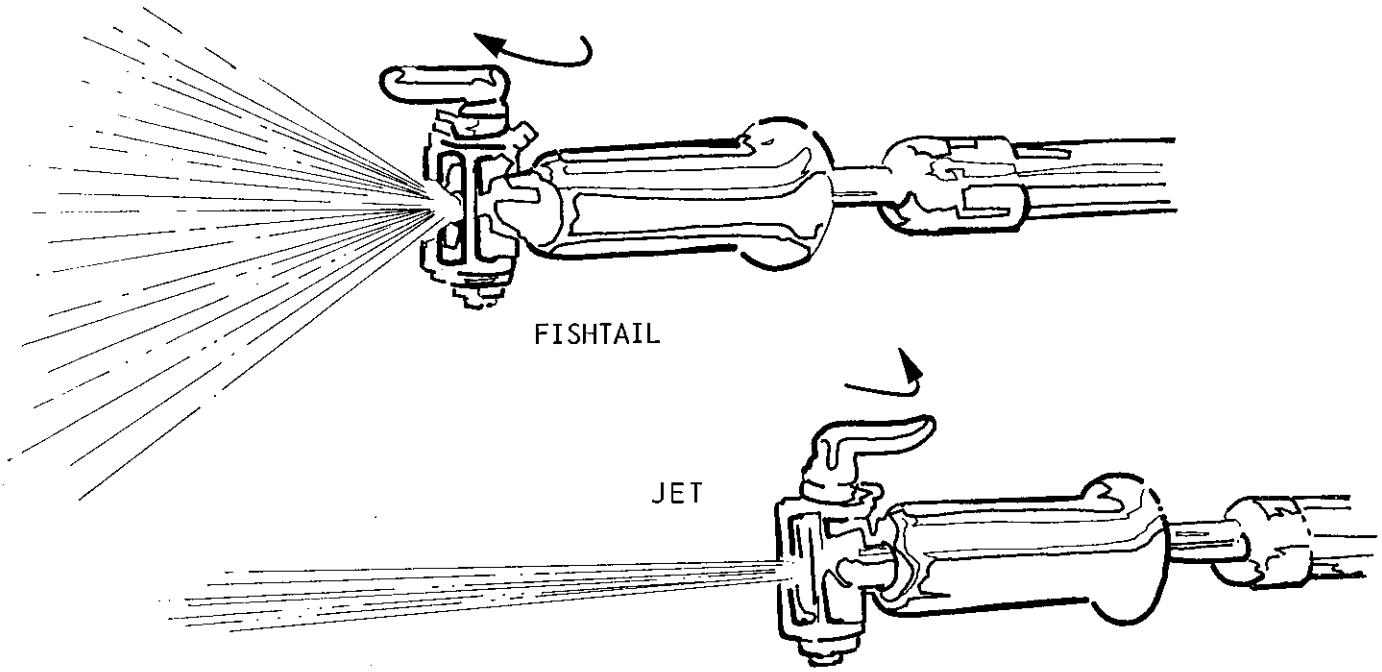
Adjust the knapsack harness to suit you and ensure that it is comfortable on your back.

The pump has a nozzle with a set-screw which is adjustable to give either a straight jet for long distance work (up to 6 metres), or a fishtail spray for close work. The "fishtail" is more economical in terms of water use where you can get close to the fire edge. At all times, consider the economic use of water by planning your activities thoughtfully

(i) Direct your water jet at the burning material and not at the flames.

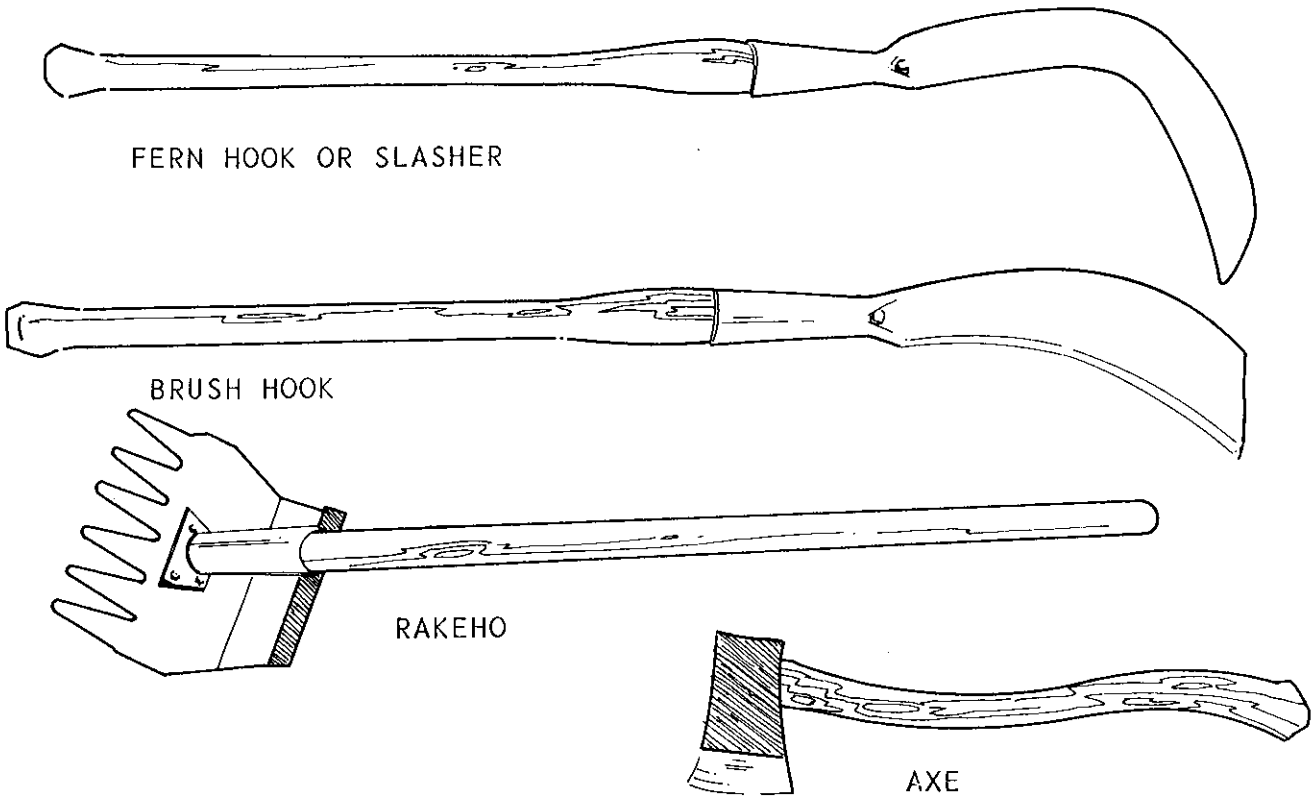
(ii) Shut off your nozzle when water is not required.

(iii) Use a jet stream for initial knockdown but then change to spray so that the water is covering the greatest possible area.



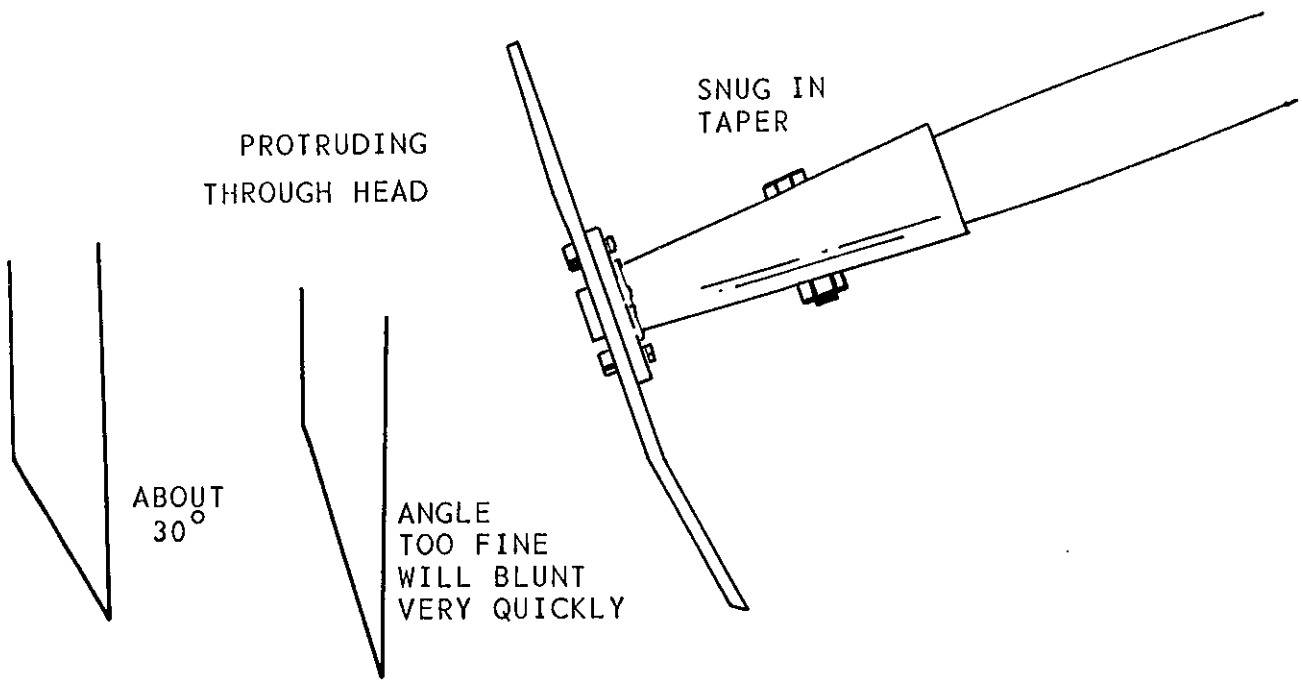
2. HAND TOOLS

There are many hand tools which can be used when suppressing a fire but this module covers the four tools normally available to crews.



2.1 Rakeho:

Rakeho is a tool specially designed for fire fighting and is equipped with one serrated edge for raking and one sharpened edge for cutting, scraping and chipping.



Typical uses:

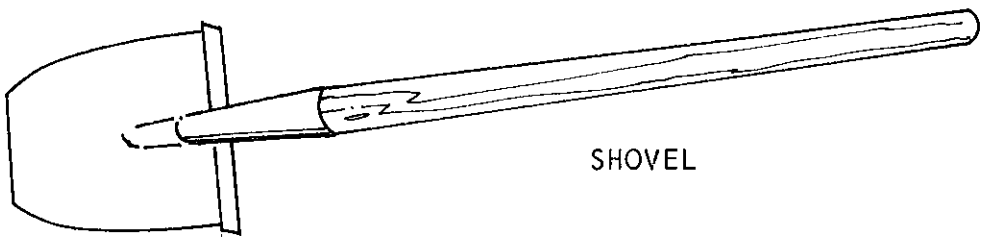
(a) Chipping trails

(b) Raking litter

(c) Scraping bark from tree trunks.

2.2 Shovel:

The round mouth shovel is used for suppressing fire in country where raking is difficult, or where mineral soil is readily available to throw over burning material.



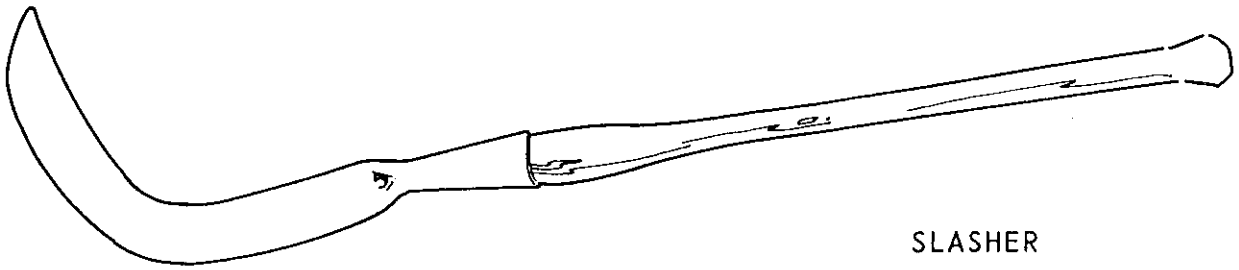
For fire control work they should be modified by cutting off the point to leave a 5" face and then sharpening this and leading edges.

2.3 Slasher:

Typical uses:

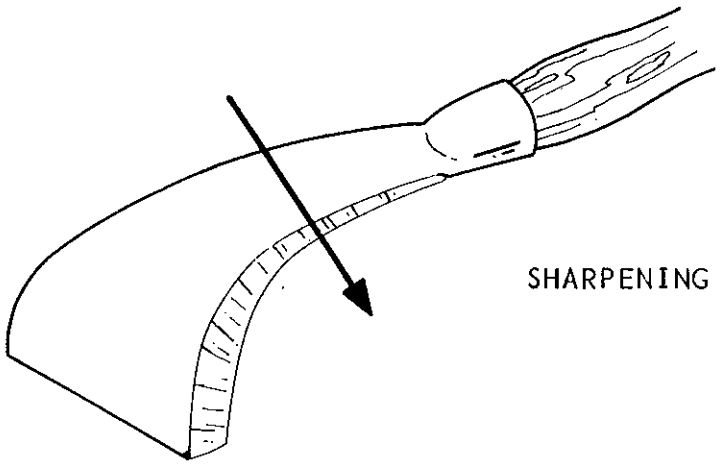
(a) Initial scrub clearing to prepare a fire trail.

(b) Clearing area for safe siting of unit and crew.



SLASHER

2.3.1 Slashers should be sharpened with a file or stone and it is simply a matter of following the angle ground by the manufacturer.



SHARPENING

2.4 Axe:

The axe is one of the most widely known tools as it is used for a variety of jobs, including fire fighting.

Typical uses:

(a) Felling trees

(b) Removing branches and limbs

(c) Cleaning bark from trees

(d) Cutting small logs off tracks.

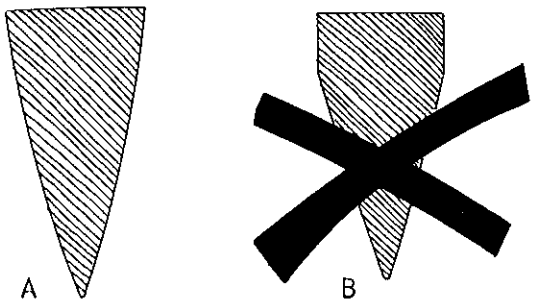
It is quite in order to keep one or two blunt axes on a bushfire vehicle for such jobs as grubbing smouldering stumps, but the remainder of your axes must be correctly sharpened at all times.

Store correctly - with a cover over the sharpened edge.

Regardless of the type of work performed, all axes must have secure handles, as a head flying off a handle can cause serious injury.

2.6 Sharpening:

Sharpen with a file and stone, as shown below.



Sharpening angle: correct/incorrect.

Sharpening as in A leaves the cutting edge with sufficient support to withstand the most vigorous use.

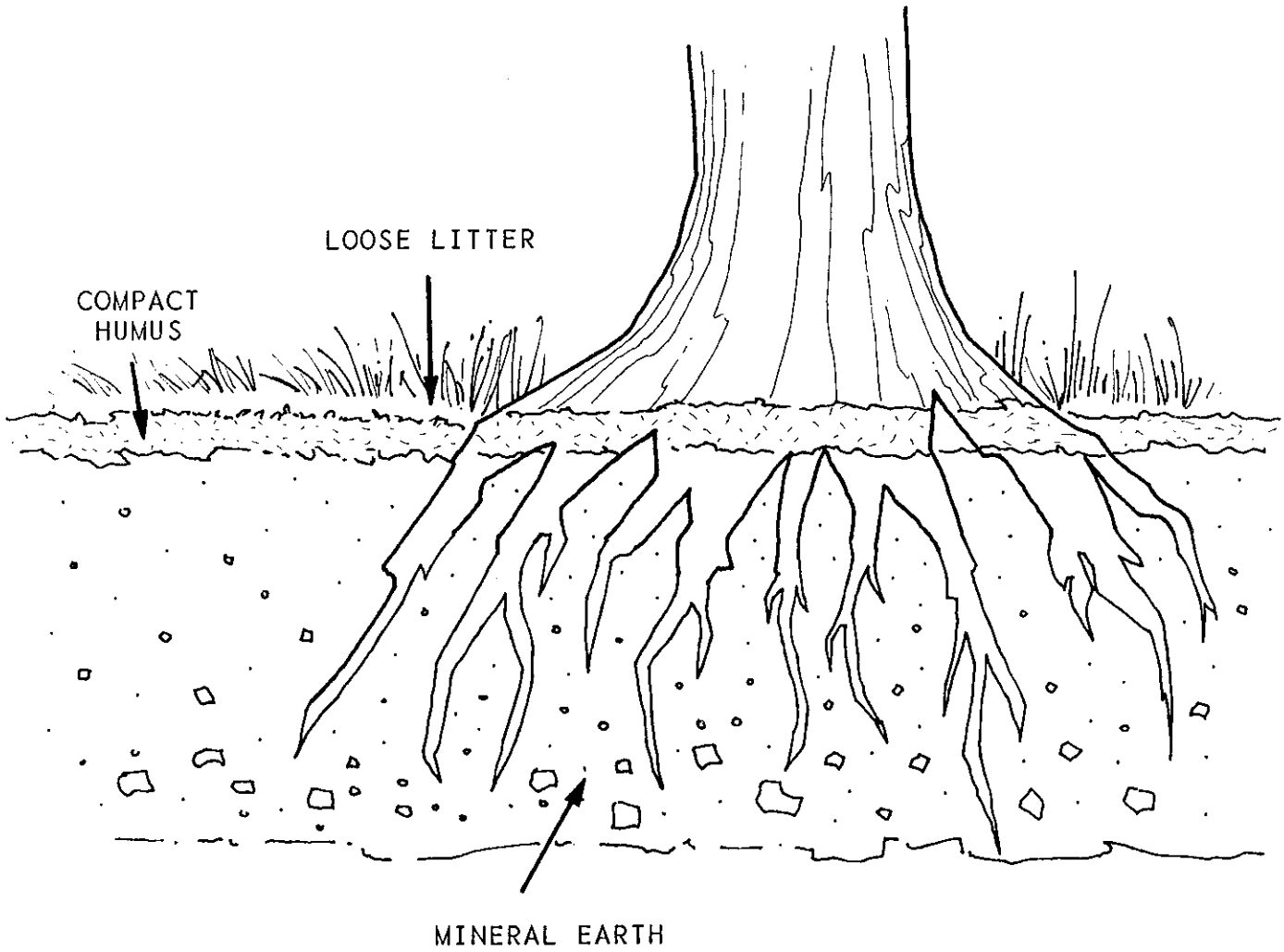
Do not sharpen as in figure B. i.e. hollowed out.

NOTE: New axes usually require re-sharpening for maximum efficiency.

3. CONSTRUCTING FIRE TRAILS AND FIRE BREAKS

Fire trails and fire breaks, as the names suggest, are cleared paths which will prevent the spread of the fire by removing the fuel from the fire path.

When constructing trails and breaks you will hear the term "mineral earth". This term refers to ground where all vegetation cover has been removed and only rocks and soil (minerals) are exposed. A fire can travel very slowly through grass roots or decayed vegetation and great care must be taken to ensure that mineral earth is exposed throughout the length and width of the trail. Consider the diagram which shows a cross-section through a typical forest floor.



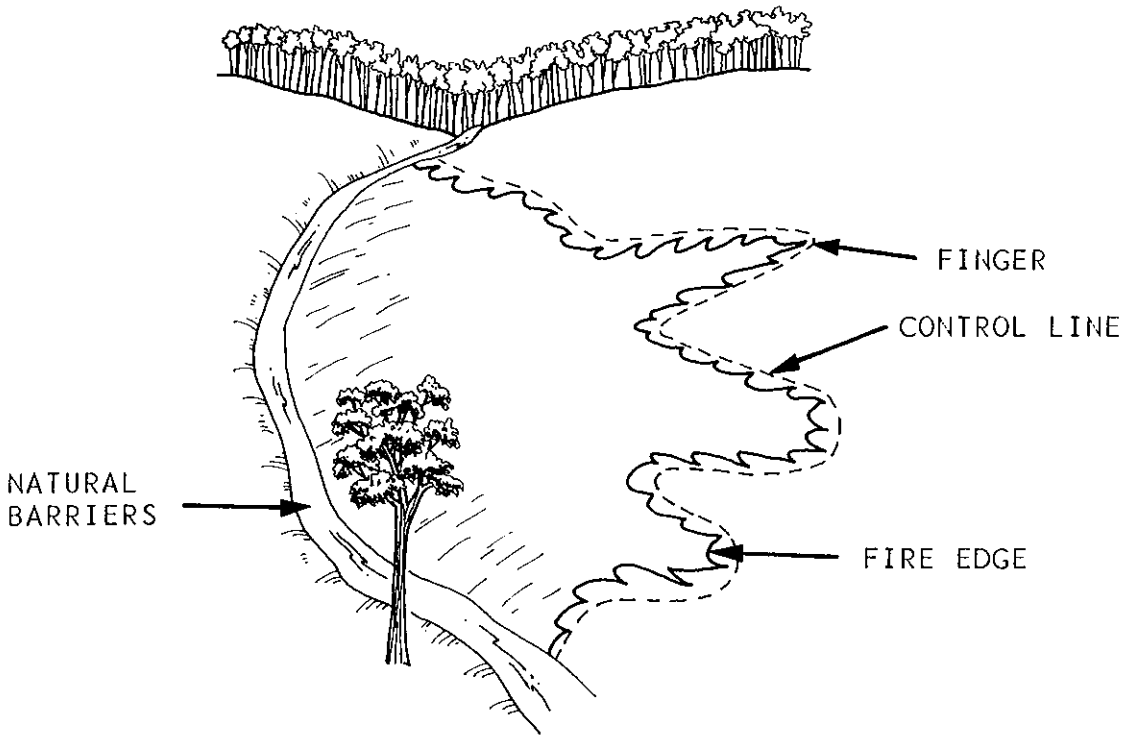
5. METHODS OF ATTACK

Irrespective of the method of attack, in all except extreme conditions, the headfire sector should be attacked first, since this is the most rapidly extending portion of the fire. Flank fires can be suppressed later.

5.1 Direct Attack:

A direct attack on the headfire with handtools, packsprays and other available gear should be carried out wherever possible. The fire will be contained by dousing with packsprays and fuel separation with handtools. Handtool attack procedures should be practised on trial fires with varying numbers of men to gain practical experience.

DIRECT ATTACK



The headfire is the most rapidly extending section of the fire and so an initial attack at this sector will minimise the size of the fire and its perimeter.

Flank and tail can be suppressed after the headfire has been contained.

NORMAL GANG PROCEDURE

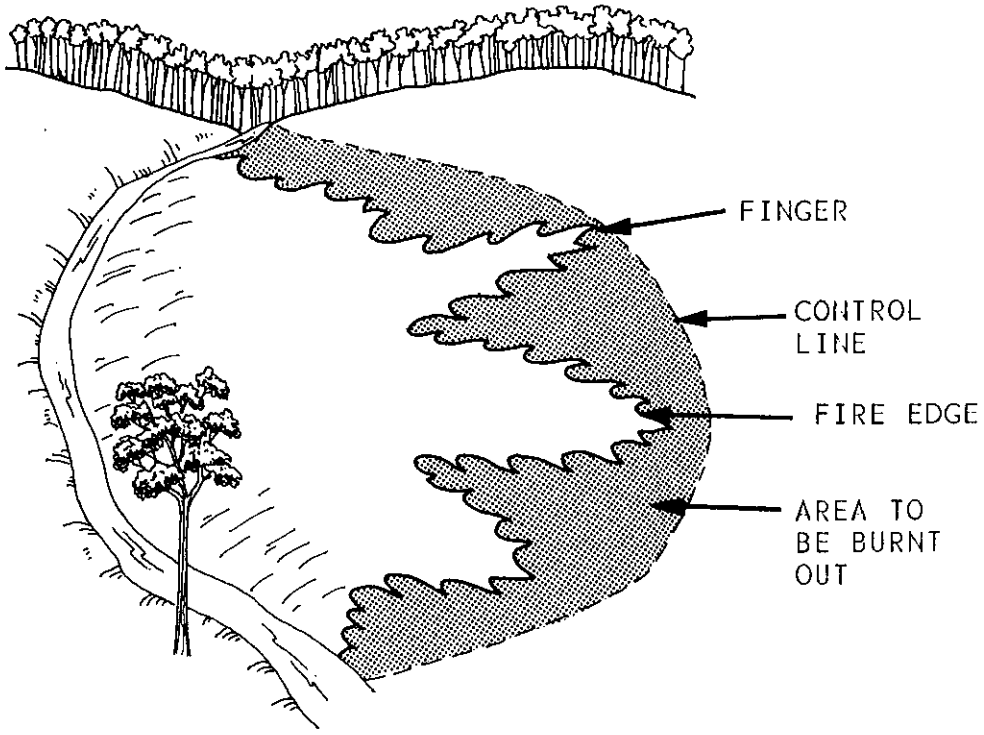
A six man gang attacks the fire in this order:

No. 1 packspray - using jets of water to knockdown flames.
No. 2 packspray - fan of water to cool fire edge.
No. 1, 2 & 3 rakers with rakehoes and shovels constructing the fire line.
No. 6 bringing up a spare rakeho or axe, and 4 gallons of water for No. 1 packspray.

5.2 Parallel Method:

When a direct attack on headfire is not possible, the parallel method should be used. This method is aimed at stopping the run of the headfire, but it also allows for more time of trail construction, and for careful selection of terrain.

PARALLEL METHOD



This method should not be attempted under severe weather conditions or in heavy fuel situations because of the high risk of hop overs and fire escapes.

6. CONSTRUCTING FIRE TRAILS

Constructing a trail is normally a group exercise and it is necessary to work in a planned manner if the group is to work safely. Remember that axes, rakeho tools and slashers

are sharp; failure to observe simple safety procedures can result in severe injury. There are two recognised methods of group working when constructing a narrow trail:

(a) the step-up method, and
(b) the one-lick method.

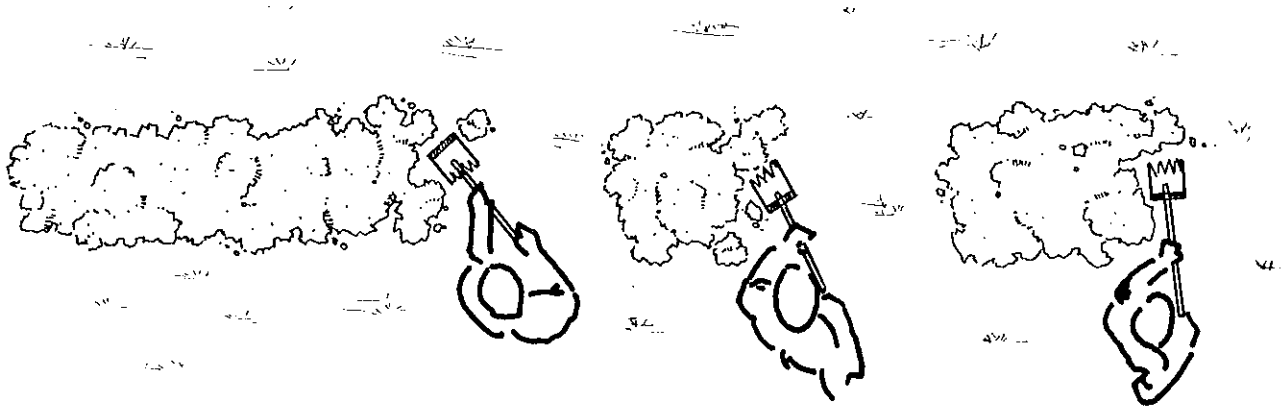
Both of these methods are designed to ensure that people do not have to pass near others using hand tools. Observe the correct procedures but, if you are required to pass close to someone using a hand tool, give a warning, "Coming through", so that he knows you are there.

6.1 Step-up:

We can safely clear a trail by the "step-up" method which is based on the idea that a group of workers in a line will each complete individual sections of the trail. The workers are spaced out, at the start of the exercise, and each worker clears a short section of the trail to mineral earth. The first person to finish a reasonable section calls out "step-up" and all workers then move on to the next unprepared section. In this way, the group moves along at a steady rate and yet no one worker is ever required to pass another.

It is normal practice to have one worker at the end of the line to make sure that the trail is properly

cleared. He does not join in the step-up routine but works as required to "polish" the trail. The group may be led by a person with an axe or brush hook and this person would not join in the step-up routine, but would clear a line for the group raking the trail. In dense vegetation the group working to the step-up routine may follow some distance behind another group reducing the vegetation with chainsaws, axes and slashers.



STEP-UP METHOD

6.2 One-Lick:

The "one-lick" method is based on the idea that each individual worker merely removes a portion of the vegetation. The group should move forward at a slow walking pace with each worker removing vegetation as he goes.

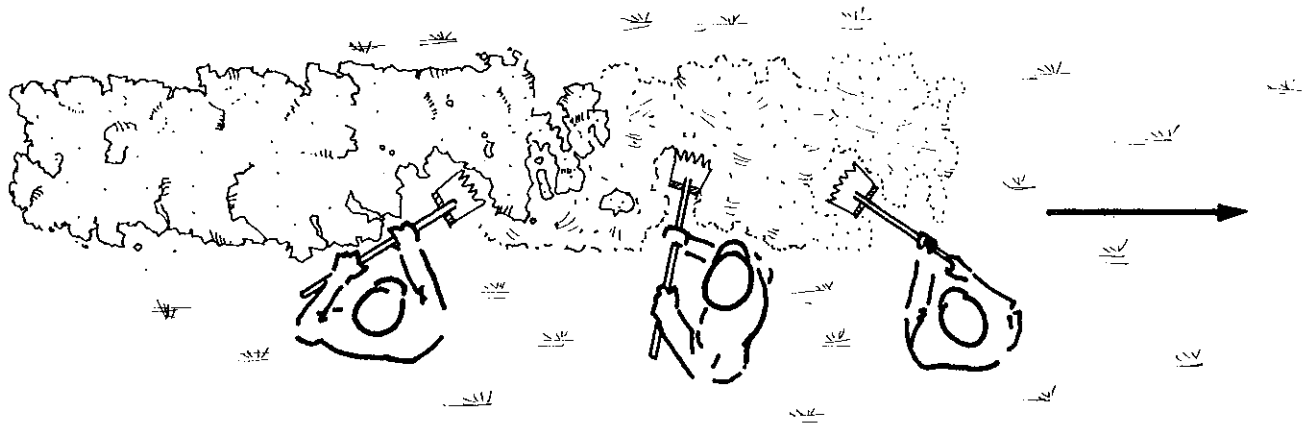
No one person completes any one section; rather several persons with rake-ho tools, for example, pass over a given section, each adding to the effort of the previous person, so that the section is progressively reduced to the stage of a completed trail.

This method is particularly useful where:

(a) we are using a variety of tools such as chainsaws, axes, slashers and rakeho tools, or

(b) where we have a large number of untrained workers.

The one lick method can be used in thick scrub, open forest, in forest litter, or, in open grass country.



ONE-LICK METHOD

7. POINTS TO BE OBSERVED WHEN CONSTRUCTING A FIRE TRAIL

Overseers or Leading hands are responsible for the proper selection of the fire trail. The following points must be considered in the trail location:

(a) Always plan the trail carefully. Valuable time and effort will be lost if you find that you have to back-track because of unforeseen obstacles.

(b) Make the maximum use of natural firebreaks such as exposed rock shelves, open ground, creek beds etc.

(c) Keep the trail as straight as possible. This will allow you a good view along the trail and will enable fire fighters to move along the trail with greater ease.

(d) Try to avoid heavy concentrations of fuel as the fire may tend to flash over it.
The fire will tend to increase in intensity where it is driven into a sharp corner.

(e) Therefore, wherever it is necessary to have corners in a trail, widen the trail accordingly.

(f) Remember that people may have to walk the trail at night. Remove all stumps or any objects protruding from the ground.

(g) Pay particular attention to areas where there may be a build-up of fuel, such as the base of a tree, and make sure that there are no places where the fire could creep across the trail.

(h) Always look up when cutting a trail to ensure that the fire will not be able to cross the trail by burning through upper-storey vegetation. The trail at ground level and above must be clear.

(i) Keep trails as far away as possible from dead trees or trees with rough bark as the bark may spread burning embers across the trail.

8. ACTIVITIES

The best way to learn about hand tools is to use them. Do not assume that you can construct a good mineral earth trail as it takes practice to develop the correct technique. Remember that hazard reduction exercises are an excellent opportunity to develop skill with hand tools.

Using hand tools is the "hard work" side of fire suppression but, by developing the correct skills, you will soon appreciate their tremendous potential.

4. BUSH FIRE SUPPRESSION

4. BUSH FIRE SUPPRESSION

1 In Section 2, we covered the fire triangle and examined the three basic methods of extinguishing fires, namely:

(a) Remove the fuel.

(b) Remove the oxygen.

(c) Cool the fire.

In this section ways of applying these to practical fire problems are looked at. The aim is to give an appreciation of the decisions which are made by fire bosses and the reasons for these decisions. Fire fighting is rather like fighting a battle; there are periods of feverish activity but there may also be periods of boredom and inactivity. You may be called upon to construct a fire break which is a considerable distance from the fire front and this may seem a thankless task, unless you understand the strategies which are being employed to suppress the fire.

It is important to understand that we can only look at a small range of fire problems in this section as each bush fire has a unique character and will behave according to the conditions prevailing at the time. We can, however, adapt the basic tactics, or variations of these tactics, to the complex fires found in real life.

We will now look at:

(a) The various terms used in fire suppression.

(b) The sequence of decisions which must be taken when suppressing a fire.

(c) Several practical problems.

2. TERMS

Firstly some of the terms used:

Knock-down -

The initial attack on a fire where water is used to reduce the intensity of the fire and to enable it to be contained.

Contain -

A fire is said to be contained once the intensity of the fire has been reduced to the extent that it can be controlled with the resources at hand and the extent of the burn can be calculated.

Mop-up -

The procedure of working around the perimeter of a fire to ensure that it is blacked out.

Blackout -

The fire has been completely extinguished and there is no possibility of re-ignition.

Patrol -

Once a fire has been mopped up the perimeter should be patrolled for a reasonable time to ensure that there is no re-ignition.

Going -

The fire is spreading on the perimeter.

Safe -

The fire can be left without further patrol.

Direct attack -

The fireline is built at the edge of the fire. This is normally achieved by removing the fuel, either with the use of hand tools or machinery and is frequently used on slow moving fires.

Head Fire attack -

The tactic of directly knocking down the head of the fire. Recommended only for low intensity fires where fire fighters can be sure that the fire will not flare up unexpectedly.

Flank attack -

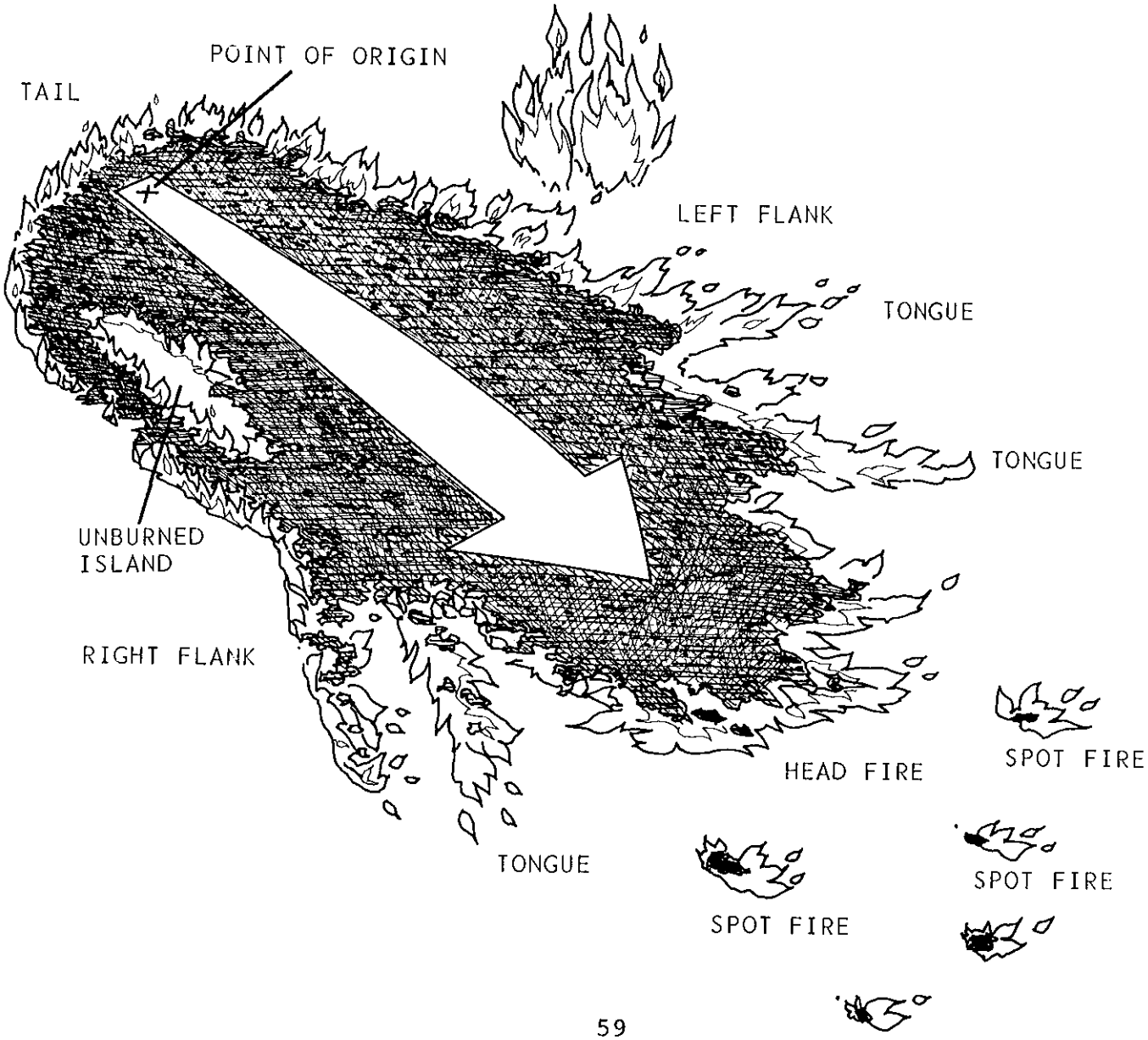
This method is used where it is impractical or unsafe to approach the head of the fire. The fire is approached from the flanks and pinched out.

Indirect attack -

Fire is contained by falling back to existing or newly constructed fire lines and these are normally reinforced by burning out or backfiring.

Parallel method -

This form of attack is a compromise between direct and indirect methods. In this method the most advantageous location of the fire line is selected close to, but at some distance from, the fire edge. The line avoids locations that would be difficult to hold.



3. DECISIONS

Let us now consider the decisions which must be faced by the person in control, when suppressing a fire.

Examine the following.

FIRE REPORT

↓

PRIORITIES

LIFE — NATURAL LAND VALUES

↓

STRATEGY

DIRECT ATTACK — INDIRECT ATTACK — PATROL

↓

METHOD

WATER — HAND TOOLS & MACHINERY — COMBINATION WATER, HAND TOOLS & MACHINERY

↓

ACTION

Refer to this diagram and imagine the combination of decisions which can be taken: there are many.

The following shows one possible combination of decisions and actions.

Fire Report - (Property threatened)

Decision to suppress

Direct knock-down with water from tankers

Contain flanks by raking mineral earth trail and patrolling with knapsack sprays

Fire burns to raked trail, spot fires extinguished, main fire mopped up

Perimeter patrolled for reasonable period

4. PRIORITIES

The main decision regarding priorities should be obvious - protecting life is the number one priority, protecting property is the second. The decision to protect property before natural land values will depend on varying circumstances and the fire fighting resources available.

Property is sometimes taken to mean houses, buildings and structures, but in the wider sense includes electrical, telephone and gas installations, fencing, livestock, and farm crops. Priorities for property protection should be considered in the light of situation, and must take into account the economic and social consequences of their

destruction. Identification of priorities will influence the suppression strategy. Protection of life, for instance, normally means an immediate attack with water in an effort to suppress the fire, whereas a severe fire in bushland may call for an indirect method of fire fighting to contain the fire.

Remember, any property can be rebuilt. Do not put yourself at risk. Life, including your own, stands as the top priority.

5. STRATEGY

When suppressing a fire we can look at four strategies.

STRATEGY 1

DIRECT ATTACK

STRATEGY 2

PARALLEL METHOD

STRATEGY 3

BACK BURNING

STRATEGY 4

PATROL ONLY

In any given situation, a combination of any of the above 4 strategies may apply.

5.1 Strategy 1 - Direct Attack

Where fire behaviour is relatively mild (e.g., flames less than 2 metres tall or spreading at a rate less than 80 metres per hour) the direct attack of head and flank fire is the preferred method.

Suppression of a fire is carried out in three stages:-

Stage 1 - Knock down

Stage 2 - Construction of a mineral - earth fire break

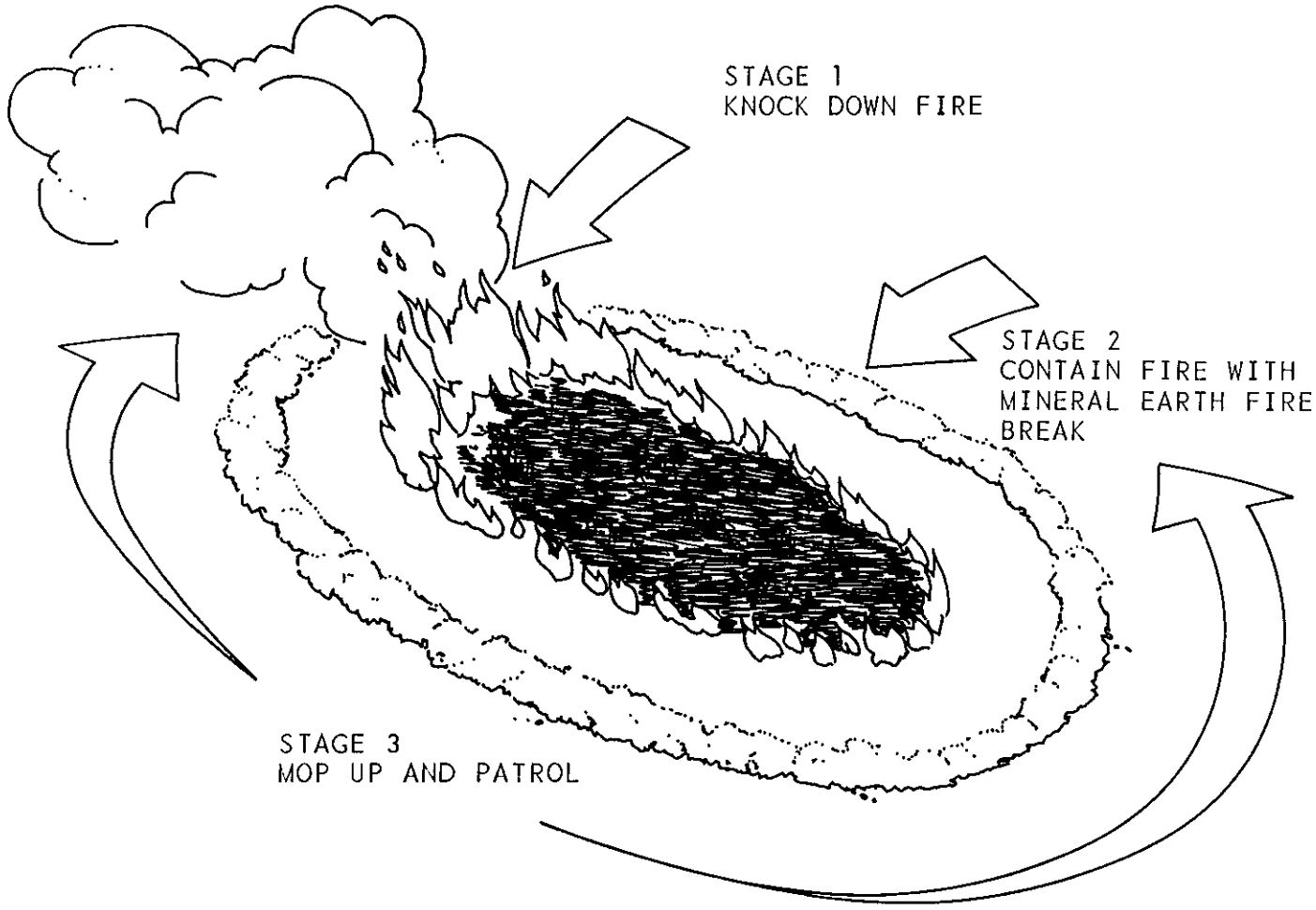
Stage 3 - Mop-up and Patrol.

The "knockdown" stage is normally carried out with water from knapsack or pumpers, or by soil or earthmoving machinery if available. This is a concentrated attack on the fire so that the overall intensity is reduced, allowing a fire break to be constructed on the fire perimeter.

Once the initial run of the fire has been checked we can redeploy some of our resources and concentrate on containing the fire by way of firebreak construction, thus minimising the area burnt. The work of containing a fire is usually carried out by establishing a mineral

earth firebreak, using either handtools or machinery. Care must be taken that width and quality of firebreak is of high standard and that there are no opportunities for fire to escape.

The final phase is to mop-up the perimeter of the fire and to patrol until completely satisfied that there is no possibility of re-ignition (the fire starting up again due to smouldering logs, burning tree stumps etc.). Consider the following diagram.



5.2 Strategy 2 - Parallel Method

This method is applied where fire intensity is relatively high, preventing a direct attack on the flame front. This method aims to stop the run of the headfire, by a firebreak, but it allows for more time for fire line construction in close proximity to the fire (e.g. 5 to 15 metres away). This method permits a better selection of terrain or use of natural barriers (e.g. bare rocks, tracks etc.). The fire line cuts across ragged fire edges and avoids locations that would be difficult to hold. The strategy is similar to Strategy 1 with the exception that we do not proceed through the knock-down stage. Instead we construct a mineral earth firebreak and use the available water to extinguish any spot fires which cross the break. Any unburned fuels between the fire line and the fire edge are immediately burned out. Once we are satisfied that the fire is contained, we mop-up and patrol as before.

5.3 Strategy 3 - Backburning

Backburning to contain a fire should only be used when strategy 1 and 2 have been considered to be ineffective or unsafe. It involves fighting fire with fire, and requires preparation of a fire line some distance in advance of the fire, or the use of existing roads and tracks. A fire is lit along the prepared line against the wind so that it will burn towards the on-coming

headfire. The junction of the two fires is always associated with strong updrafts, which may cause spotting to occur over the prepared fire line. Spot fires or hop-over will occur if the backburning was commenced too close to the headfire. There are many risks associated with this method and this is referred to in a later section.

5.4 Strategy 4 - Observe and Patrol

The fourth strategy relates to fire burning in inaccessible terrain where it is not possible to carry out successful suppression operations. This strategy is not normally implemented as weather changes can bring about dramatic changes in the fire patterns and result in blow-up situations leading to large uncontrollable fires and widespread damage.

6. METHOD

As stated earlier, we seldom use one method exclusively when suppressing a fire, as every fire has its own problems and will require different techniques.

We will now consider a number of individual techniques for suppressing or containing a fire. Note that this module concentrates on dry fire fighting and this section should be studied in conjunction with the section - "Fighting Fire with Water".

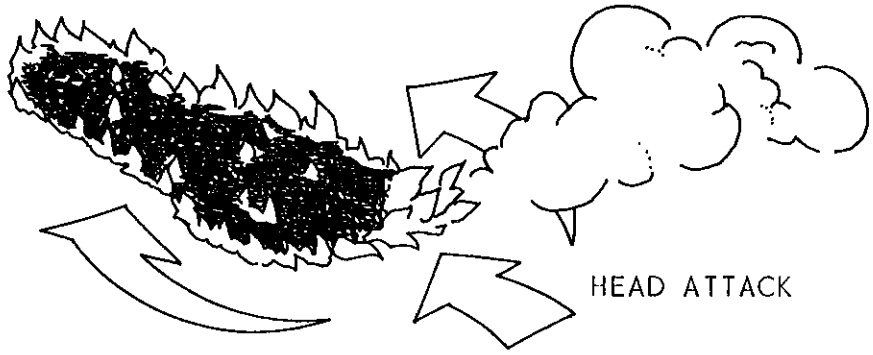
6.1 Knock-down

There are two basic approaches when knocking down a fire -

(a) Head

(b) Flank

Head - when mounting a head attack on a fire, we strike at the front of the fire and then move around the flanks gradually extinguishing the cooler, slower moving flanks of the fire.

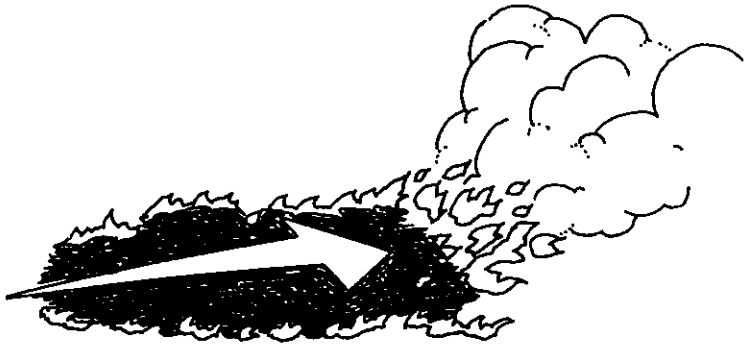


Flank - It will often happen that the fire is too intense for us to approach head on, in which case we begin with the cooler flanks and move around to the head, pinching out the fire as we go.

6.2 Warning

There is always a danger from the flanks of a fire. Consider the normal shape of a fire being drawn by wind along flat terrain.

Figure 1



The hottest section of this fire will be the head, and the flanks will be much cooler as the fire is spreading slowly outwards, but, consider a change in wind direction.

Figure 2

Figure 3

In figure 1, the fire has an elongated shape with a narrow head. Figure 2 shows the same shape but the wind has just changed and is blowing directly on to one of the flanks. Figure 3 shows the new shape of the fire. The cooler flank has suddenly become the head and a fire which was burning on a narrow front is now on a broad front. Such a change makes an enormous difference to the suppression problem but, more importantly, presents an immediate threat to those fire fighters working on the endangered flank. Always be watchful of wind changes and if unpredicted changes occur in your area, warn your leader.

6.3 Containing a Fire

This may be carried out by one of three methods:

(a) Direct

(b) Parallel

(c) Indirect (backburning)

6.3.1 Direct

This technique is used for very low intensity fires and calls for the fire fighters to work directly on the fire line. There are a number of ways in which this can be done, for example:

(a) Water from a tank or knapsack sprays to extinguish the fire.

(b) Earth moving machinery to push the burning fuel into the burnt area.

(c) Use hand tools, such as the Rakeho, to rake the burning fuel into the burnt area.

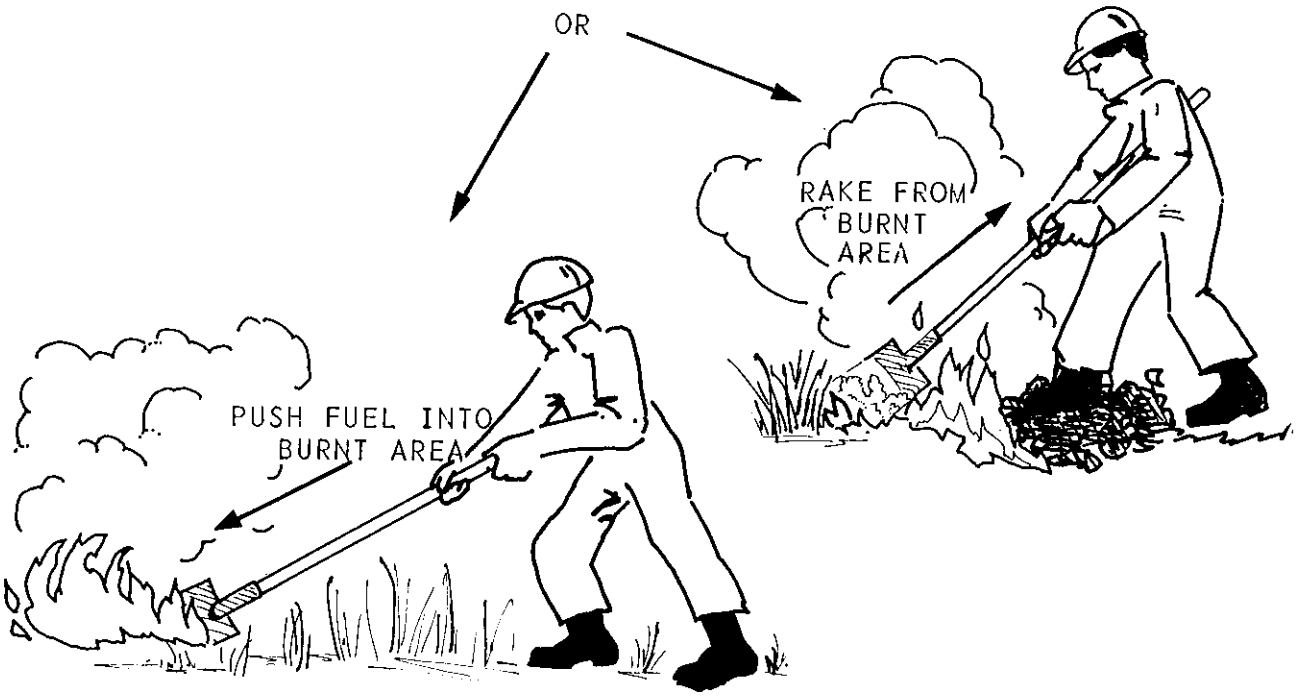
Method (c) involving the use of a Rakeho is very effective but it is also very tiring on fire fighters.

The problem is that it is not good practice to use the Rakeho in the normal raking manner. When raking the fuel from the path of the fire, care must be taken to avoid raking burning material into the unburnt fuel and so spreading the fire. There are two ways of overcoming this problem:

(i) Push the burning material back into the fire.

(ii) Rake from the burnt side of the fire front.

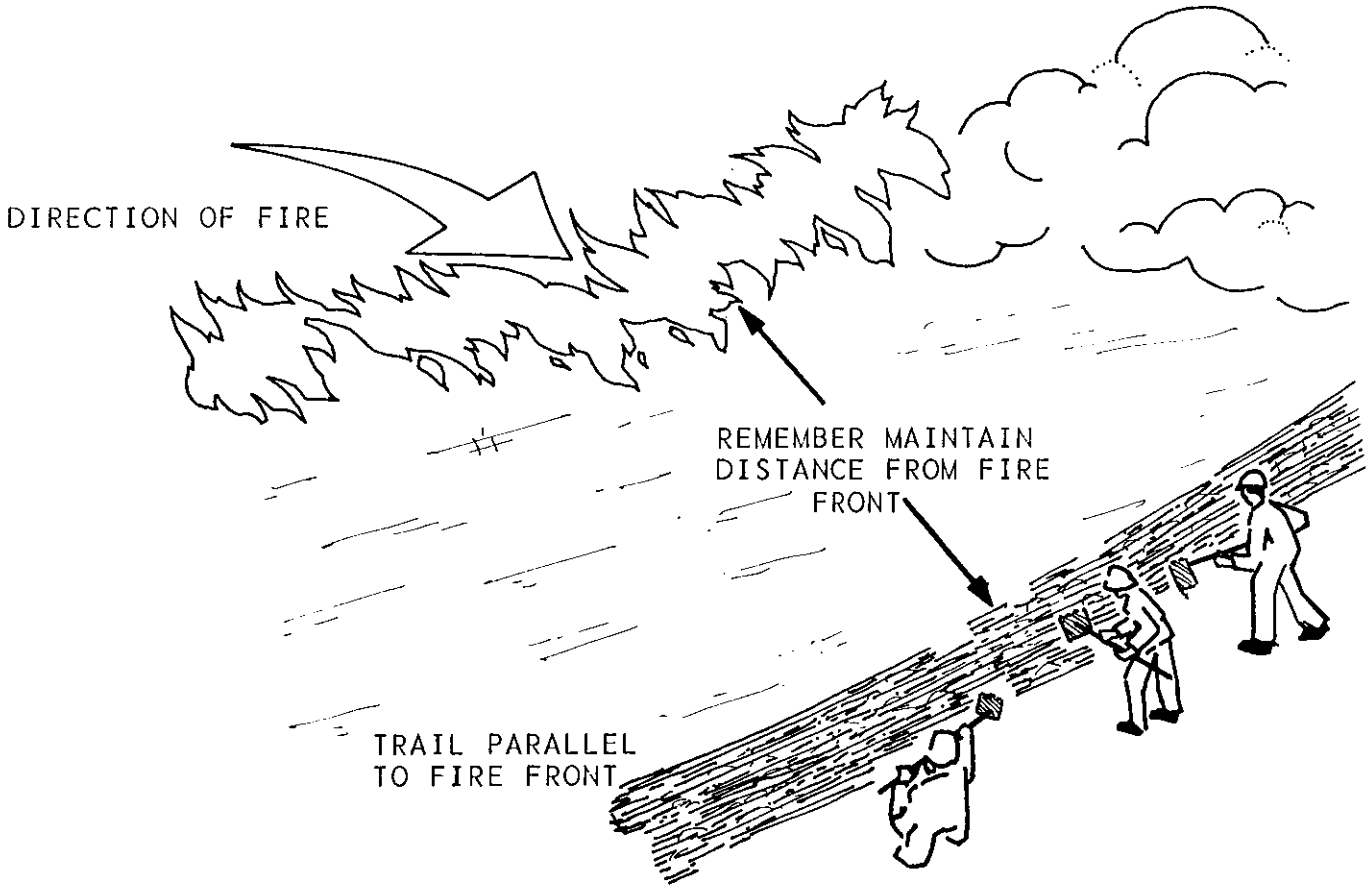
Both of these methods are very effective but they are also very tiring as you are working close to the heat of the fire.



6.3.2 Parallel

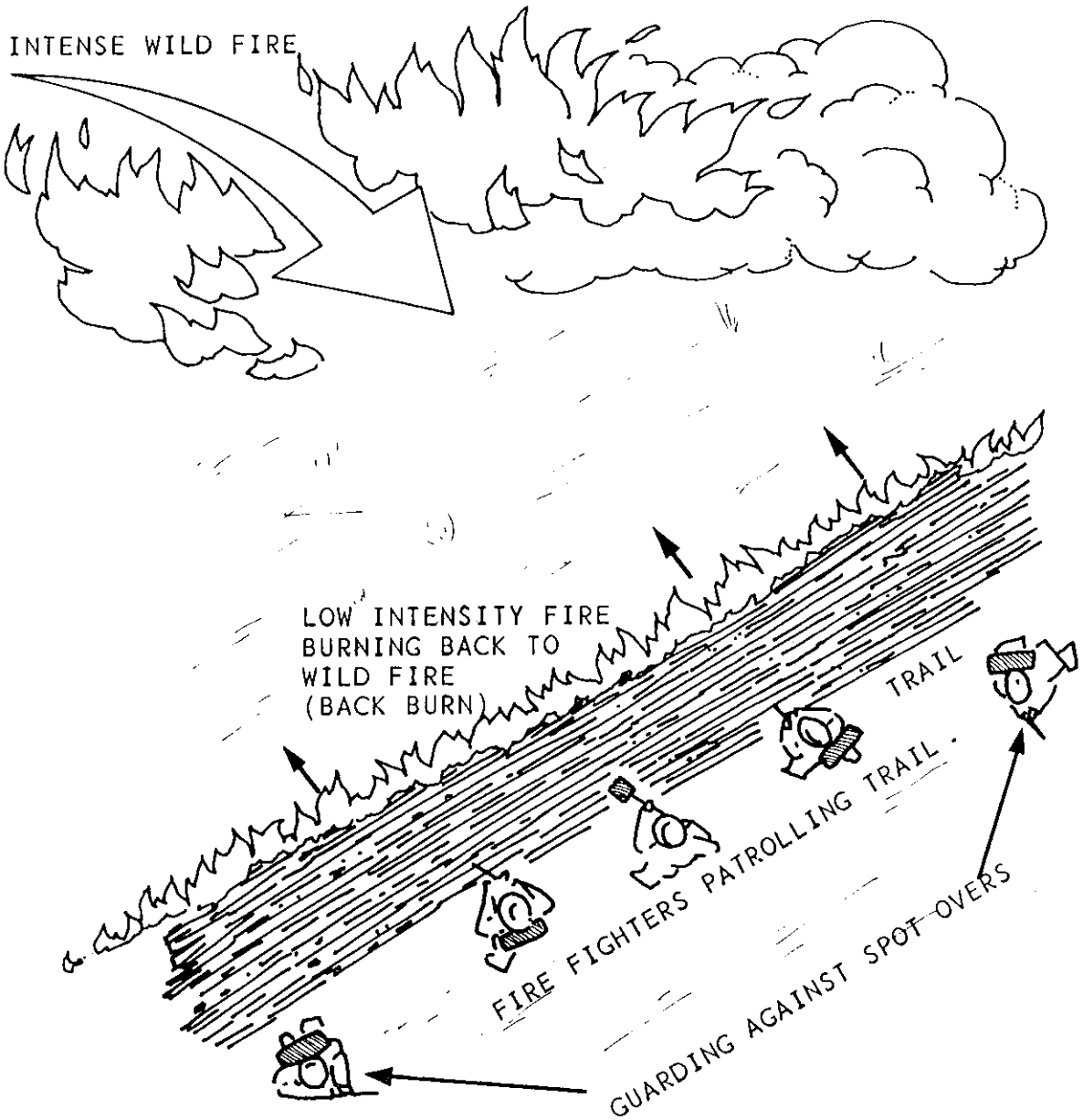
We can overcome the difficulties of the direct method by raking a trail parallel to the fire front. This technique is used for low to medium intensity fires and has the advantage that it allows fire fighters to work back from the heat of

the fire and yet still minimises the burnt area. The distance back from the fire will depend on the intensity of the fire, the type of fuel, weather conditions, etc., but it would be normal for the trail to be within 5 to 15 metres of the fire front. There is one important warning when using the parallel method - remember that the fire is continually moving. You may start a trail 10 metres from the fire only to find that, before your line is complete, you are suddenly too close to the intense heat of the fire front. When using the parallel method, plan your trail carefully and continually watch the fire front.



6.3.3 Backburning

We employ the backburning method where we have very intense fires and it is necessary to work well back from the fire front. In this method it is necessary to prepare a trail, or use an existing "natural" break, such as a road or fire line, and back-burn toward the main fire, thus depriving this fire of fuel. It may be possible to use a previous fuel reduction burn as the base line for the backburn.



6.3.4 A Caution on Backburning

The backburn method is a proven, and very effective, method of suppressing fires, but there is one great danger - the backburn itself. Backburning is a task for the expert and many problems have been caused by inexperienced people spreading a fire through the improper use of backburning. Make sure that you know when and how a backburn is to be lit and obey all instructions of the person responsible for the burn. Remember, too, that you must know exactly where backburn lines will start and finish so that the ends can be tied-in.

The person in charge of the backburn is responsible for seeing that the burn is kept at the level where it can be contained and the task of fire fighters is to ensure that the fire does not cross the trail. This work is often carried out at night, when conditions have eased.

A few simple precautions:

1. Never commence a backburn until the officer in charge gives approval.

2. Do not spend too much time looking at the fire - the real need is to watch for any

fires starting in the unburnt country across the trail.

3. Look up and make sure that the wind is not carrying burning debris into the unburnt country. Watch the unburnt country for smoke which would indicate that the fire may have "spotted".

4. Keep an eye on trees near the edge of the trail in case a fire has caught in the limbs. This presents a very real danger of sparks blowing across the break, or of burning limbs or old tree trunks falling across the trail.

5. Use the water in your knapsack spray sparingly but cool down hot spots close to the edge of the trail.

6. Keep patrolling the trail until your crew leader is satisfied that the perimeter is safe.

7. MOPPING UP AND PATROL

7.1 Mopping up

Mopping up is the term used for the work done in rendering a fire safe after it has been brought under control.

It involves completely extinguishing every piece of burning material that might permit the fire to escape.

Five major rules must be followed:

1. Along the edge of the fire a strip must be cleared to mineral soil for a width of at least 1 metre (more if scrub fuels necessitate it).

2. All low stumps or logs within 20 metres of the edge must be extinguished with water or mineral soil or both.

3. All burning trees or spars within 100 metres of the edge must be extinguished, or felled, or burnt around to provide an adequate margin of safety.

4. Heaps of smouldering debris, logs or tops must be broken up, separated, dispersed and then thoroughly extinguished if near the edge. Move smaller material well into the burnt area.

5. Unburned pockets inside the fire edge should be burned out if possible, under controlled conditions.

Remember that much work can be saved by intelligent preparation and burning out of edges - e.g. raking around trees, scraping rough bark and watering down drysiders - either at uncontrolled fires or when control burning.

7.2 Patrol

It is necessary to mount a patrol frequently until the fire is safe, to detect:

(a) Weaknesses in the fire line or trail.

(b) Potential sources of re-ignition, for example smouldering logs, stumps or stag headed trees.

(c) Spot fires which may have been thrown well ahead of the main fire, and therefore into unburnt country. Concentrate your inspection on the unburnt country rather than the fire itself.

8. ACTIVITIES

1. Try to become involved in controlled burning exercises so that you can gain practical experience at burning from a prepared line.

2. Identify areas within your district that should receive high priority for hazard reduction by controlled burning.

3. You should know how to safely deploy a tanker and crew at a fire. Discuss theoretical fires, as a group, and consider how you would deploy your resources for each fire.

5. FIGHTING FIRE WITH WATER

5. FIGHTING FIRE WITH WATER

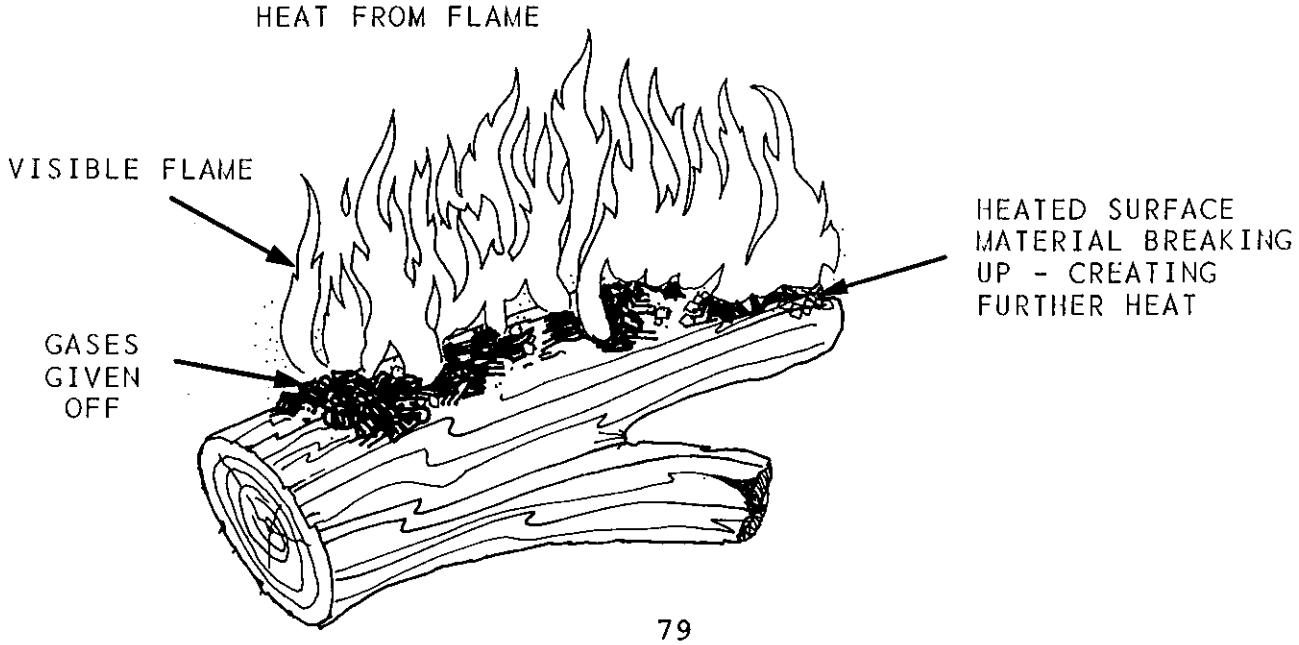
1. Water is undoubtedly the greatest weapon we have to fight fires. Water is used to cool the fire, but a large fire may call for a large volume of water and the economic use of water is the key to efficient fire suppression. In this module we consider:

   (a) the physical effect of water on fire;

   (b) the most economic methods of suppressing a fire with water;

   (c) the pumps, hoses and fittings used for fire fighting.

   Let us look firstly, at the physical effect of water on a fire. We talk of water cooling a fire but what exactly is the water cooling, and how? If we look at a fire, in simple terms, we find a chain reaction where heat causes a material to vaporise; this vapour then burns; the burning vapour produces heat which may, in turn, cause other material to vaporise. In the process, the material breaks up by chemical action and this action creates more heat. Let us look at a single log of wood.



REMEMBER that the whole burning process relies on the heat generated by the material breaking up on the surface of the log.

Extinguishing the fire is a simple process - cool the log. This is the most important single principle of fire fighting. Look at the diagram again - the flame which we see is the result of gases burning, gases given off by the heated log. Attempting to extinguish the flames is a useless exercise as the heated log will merely give off more gases; the answer is to cool the log.

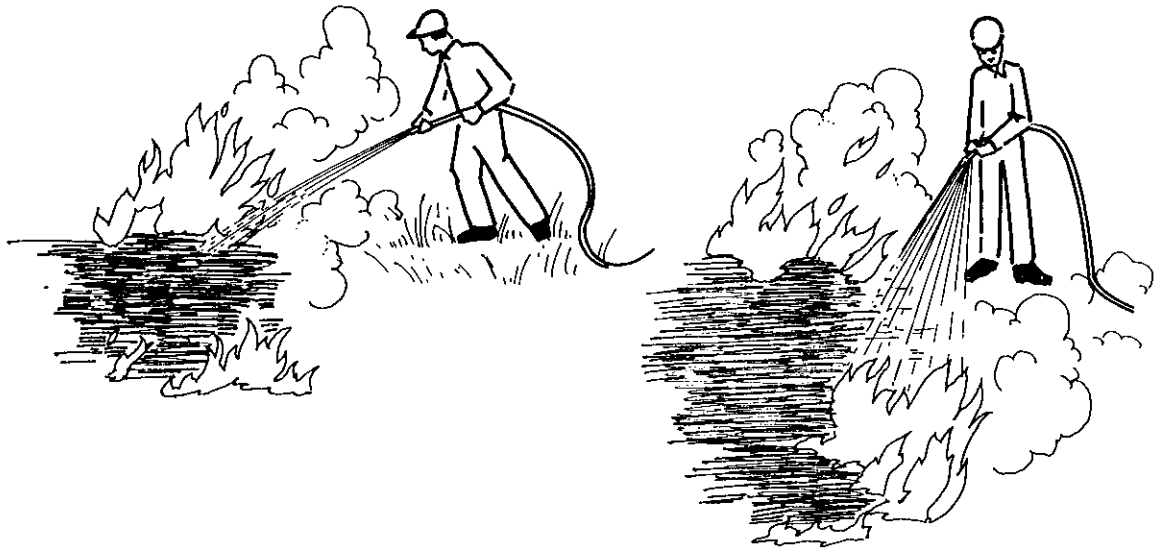
ALWAYS DIRECT YOUR WATER JET AT THE BURNING MATERIAL AND NOT AT THE FLAMES

This simple rule should dictate your point of aim at all times and so help you to conserve precious water. Let us look at a common problem to see how we must carefully consider the point of aim so as to ensure the greatest cooling effect.

We have so far looked at the correct point of aim; let us now look at nozzle adjustment and angle of aim. Always consider the type of nozzle to meet the particular task. It is a good tactic, where possible, to attack a fire with a strong jet and cool down one area so that you can then move in, turn the nozzle to spray, and widen this safe area.

ESTABLISH LINE WITH STRONG JET

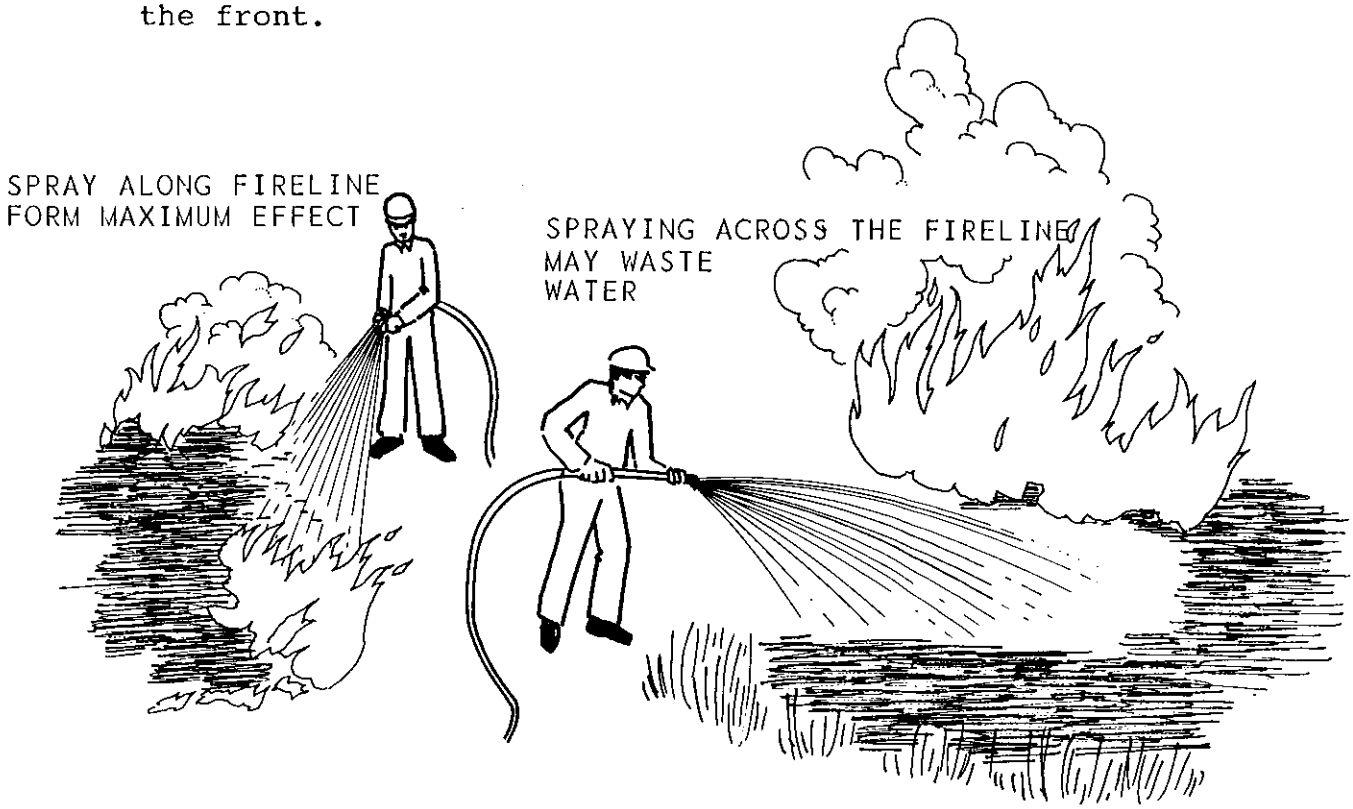
EXTEND LINE WITH SPRAY



Once you are able to move around the fire front, use your water wisely by spraying water along - rather than across - the front.

SPRAY ALONG FIRELINE FORM MAXIMUM EFFECT

SPRAYING ACROSS THE FIRELINE MAY WASTE WATER



2. ECONOMY OF WATER

The main point to remember is that you must use the correct amount of water for the job. Make sure that the fire is blacked out, but turn the nozzle off when not actually suppressing the fire or cooling surrounding fuel. Keep in mind the following facts:

(a) A standard knapsack spray contains 16 litres of water. The spraying capacity of a knapsack spray pump is approximately 3 litres per minute. This means that, if spraying continuously, you will empty a knapsack in a little over 5 minutes. Consider this if you are a distance from the refilling point - use your water wisely.

(b) The small "light Patrol" fire units used by this Department have a capacity of from 450 to 680 litres of water and can be emptied in approximately 5 to 7 minutes through a 10 mm director.

The large 2700 litre "Heavy Duty" fire units with a high capacity motor/pump combination can be emptied in less than 5 minutes using a high volume director.

To ensure that water is used economically, be continually conscious of the water problem and plan your activities thoughtfully in the following ways.

(i) Use appropriate hoses and always select the smallest nozzle which will the do the job effectively.

(ii) Shut off your nozzle when water is not required.

(iii) Use a jet stream for initial knock-down but then change to spray so that the water is covering the greatest possible area.

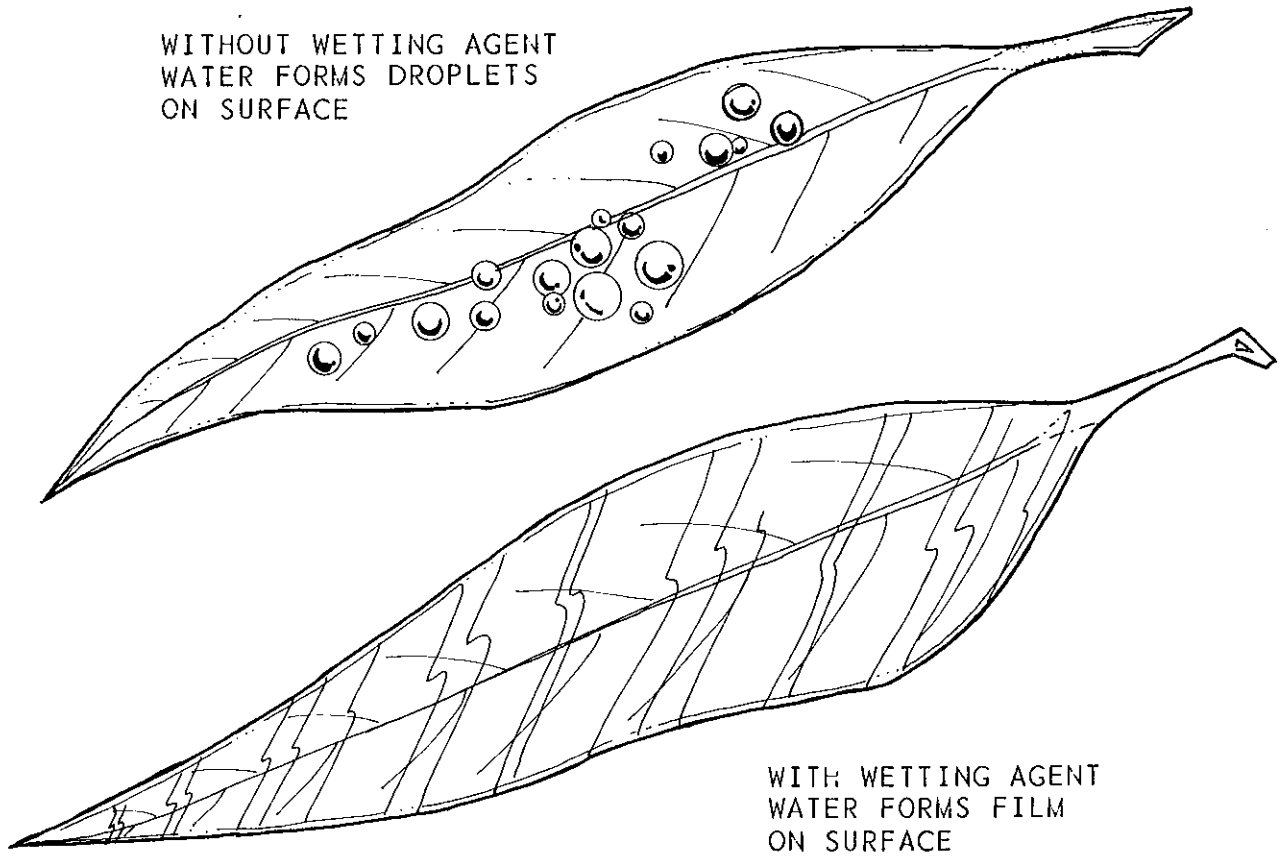
(iv) Direct water at the point where it will have the maximum effect - the fuel, not the flame.

(v) Break up solid burning material, such as logs, so that the water penetrates into the centre where it can have the greatest cooling effect.

(vi) Run pumps at the speed necessary for the task. Operating a pump above the required speed will consume an unnecessary amount of water: it may also cause damage to the pump.

(vii) If possible use a retardant or wetting agent in the water. Chemical fire retardants such as Di-ammonium Phosphate (AMGARD) are generally used to slow down the combustion process. Thus retardants are used to buy time and reduce the effort necessary to suppress and mop up fires. By the correct use of fire retardant the effectiveness of water can be increased by up to five times. Where possible retardant should be applied as a fine spray.

Wetting agents are chemicals which, when added to water, break the surface tension causing it to spread out and so cover a greater area. The following diagram shows a leaf sprayed with water, and, the same leaf sprayed with a similar volume, to which wetting agent has been added.



A caution on wetting agents and retardants: They can be corrosive. Thoroughly flush all knapsack sprays and pumps after use.

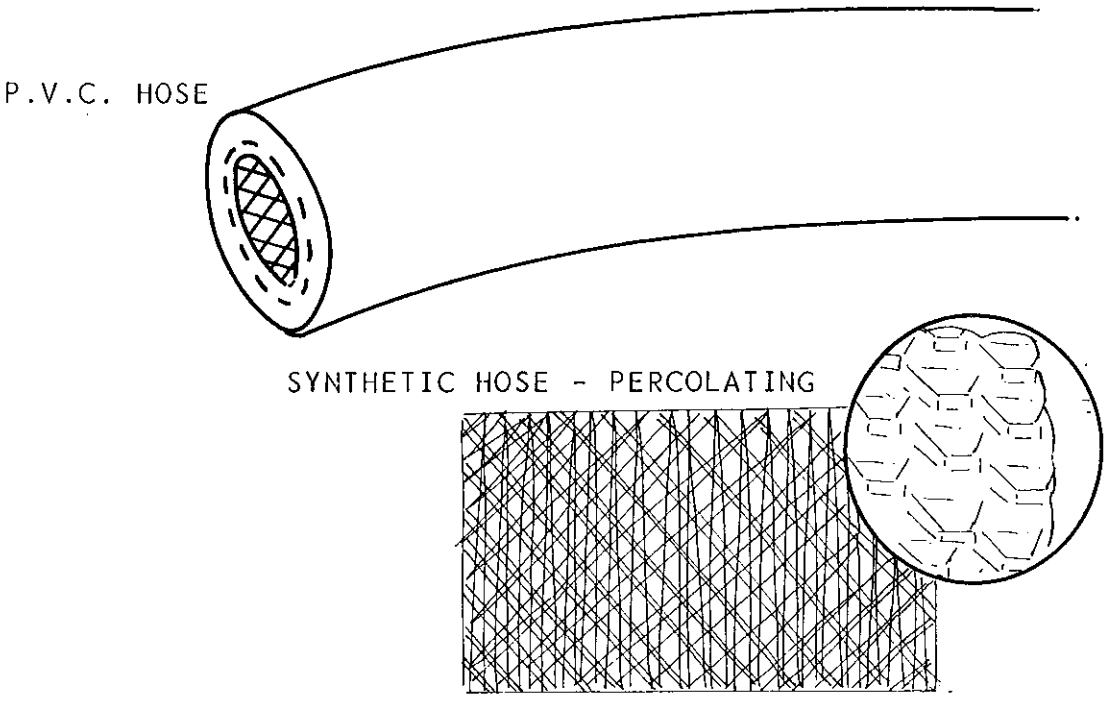
3. HOSES

There are four basic hose types used in W.A. for bush fire fighting.

1. P.V.C. 19 mm & 12.5 mm.
2. Canvas 38 mm delivery.
3. P.V.C. suction hose - nylon reinforced 38 mm & 63 mm.
4. P.V.C. layflat 38 mm delivery.

3.1 <u>P.V.C. Hose</u> (19 mm & 12.5 mm) is used on live hose reels. Being a thermo-plastic, it is susceptible to damage by fire and must be layed clear of burning logs, stumps, embers etc.

The hose used by this Department is high pressure (6890 kpa) - (1000 psi) of ribbed construction to lessen the effect of scuffing. It is coloured yellow to make it clearly visible particularly on burnt ground.



3.2 Canvas Hose 38 mm

There are two types used by this Department.

3.2.1 Percolating Hose:

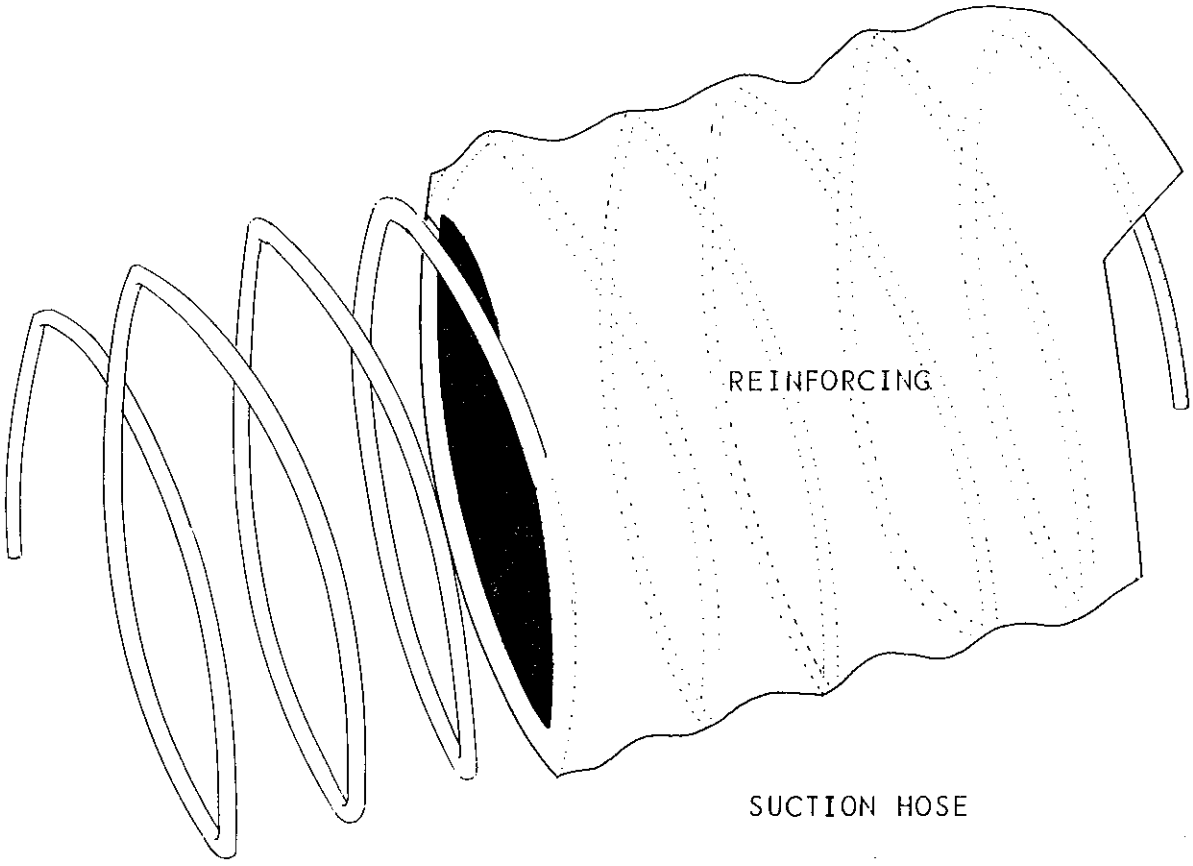
This is the common type used in bush fire fighting in W.A. The latex lining is punctured with small holes allowing water to leak through and dampen the outer cover, thus protecting the hose from fire.

3.2.2 Rubber Lined:

Non-percolating latex lined and is used in situations away from the fire face such as relay pumping.

3.3 Suction Hose 63 mm and 38 mm

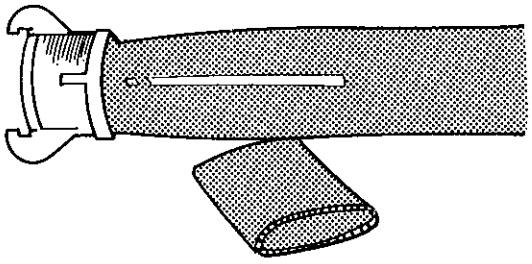
P.V.C. hose reinforced with a nylon spiral, used for drawing water from a tank, dam or river. The nylon reinforcing prevents the hose from collapsing under suction. U.V. stabilized, grey colour is used by this Department.



SUCTION HOSE

3.4 P.V.C. Layflat 38 mm

P.V.C. "Red" layflat 6890 kpa (1000 psi). Mainly used as 3 m and 7 m short lengths for high pressure delivery.



LAYFLAT HOSE

3.5 Precautions

All hoses are vulnerable to damage through mishandling:

(a) Do not drag hose over rough surfaces.

(b) Do not run over hose with vehicles.

(c) Avoid contact with oil, grease, paint etc.

(d) When in use keep clear of burning embers.

(e) Clean, dry and store correctly when not in use.

4. DIRECTORS - NOZZLES - BRANCHES - COUPLINGS

4.1 Director:

A tapered conical tube attached to the hose to direct a jet of water at the fire.

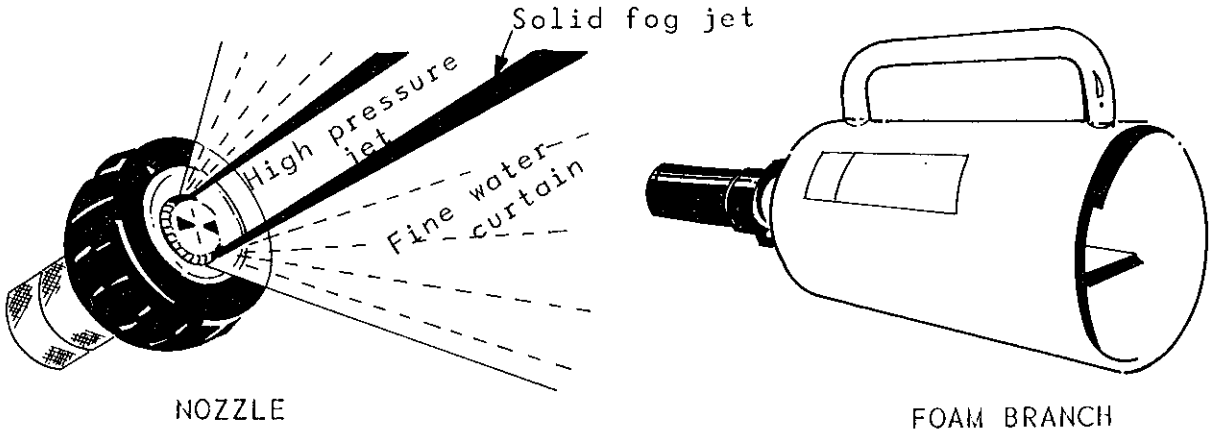
4.2 Nozzle:

A fitting attached to the hose which can be manually changed from jet through to fine mist.

4.3 Branch:

A device attached to the hose to make and apply medium expansion fire fighting foam.

DIRECTOR

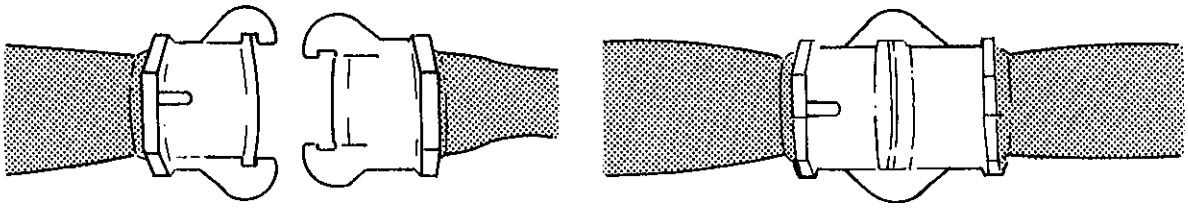


NOZZLE

FOAM BRANCH

4.4 Hose Couplings 38 mm Hermaphrodite (Identical)

HOSE COUPLING 38MM HERMAPHRODITE (IDENTICAL)



Hermaphrodite or instantaneous coupling (W.A. - C.A.L.M.) type. These are used throughout this Department, they allow greater flexibility as either end of a hose may be connected to pumps, nozzles or directors.

Ensure that sealing washers are correctly fitted and have not been damaged.

5. PUMPS

It is essential that fire fighters have an understanding of the function of a pump and the purpose of "priming".

Quite simply, a pump is a machine for giving energy to water. We take water which is normally at rest in say a dam, tank or lake. We then force that water through the outlet of the pump so that the water is now moving. The amount of water forced through the pump (the volume) and the force with which it moves (the pressure) will depend upon the power and design of the pump. Pumps are normally designed with a specific purpose in mind - that is, they are either designed for large volume or high pressure.

5.1 Pressure pumps are used for direct fire fighting where we are concerned with moving water at a high velocity. This allows for a jet of water to be directed at the base of the fire from a safe distance.

(a) Low-Medium Pressure Pumps

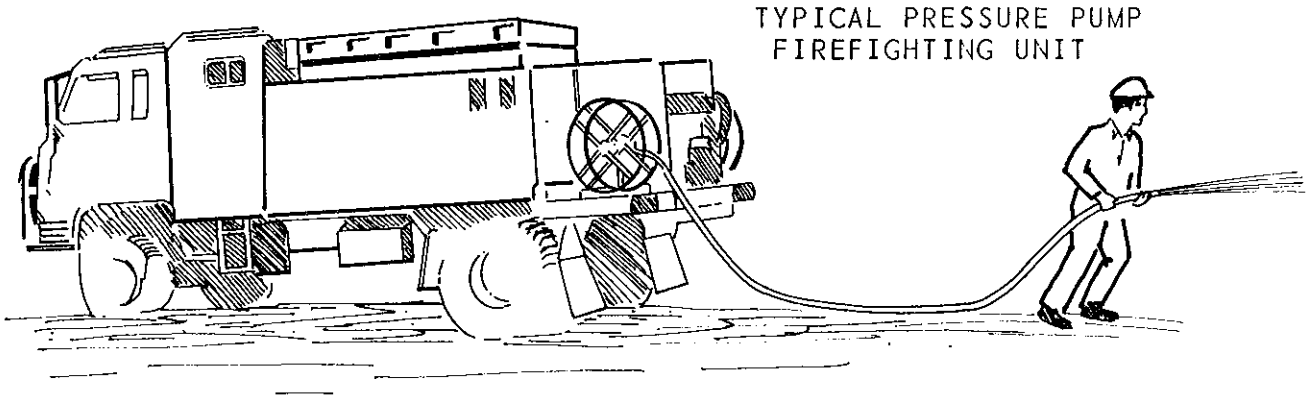
(1"-1½" driven by 5-7 H.P. motor).

Normally self-priming pumps and are used on light patrol and gang truck units.

(b) High Pressure Pumps

(2" High lift driven by 25 H.P. motor).

Holden motor/Stalker pump combination fitted with vacuum priming pump and fitted to the all purpose heavy duty fire unit.



TYPICAL PRESSURE PUMP FIREFIGHTING UNIT

(c) High Performance Portable Pump

These are used mainly for relay pumping of water over long distances or up steep gradients. They are powered by high performance two stroke motors, close coupled to a multi stage pump. Priming is through a vacuum pump.

5.2 Pump Filters

Pumps used for bush fire fighting are often called upon to pump water direct from streams and water holes. This water usually contains sticks, leaves, pebbles and

grit etc. It is therefore essential that the suction and in-line filter systems are regularly cleaned and kept in good order.

5.3 Pump Priming

Priming is the action of drawing the air out of the suction line so that atmospheric pressure will force the water up through the suction line to the pump.

For priming to be effective it is essential that valves, hose, pump packing and seals are maintained in an air-tight condition.

Remember that the pump gives energy to the water on the output side, but it is atmospheric pressure that forces the water to the pump. Therefore do not expect to draw water from a vertical lift of more than 5 metres.

Make sure you understand the priming procedure for your particular pumps.

5.4 Safe Pumping Operation

High pressure water jets can be extremely dangerous.

For safety and water economy, use the minimum motor R.P.M./pump pressure required to carry out the task, be it fire knockdown or mop up.

Do not operate pumps above 1700 kpa (250 psi) unless a greater pressure is required for high lead or relay pumping.

Understanding and communication between operator and hoseperson is essential at all times.

5.5 Pump Maintenance and Storage

The regular maintenance and correct storage of pumping units is an important part of the operators duty.

It is essential during the prescribed burning and fire season that daily and weekly maintenance checks are carried out.

During the winter months, pump units must be stored under well ventilated cover and in such a manner that weekly maintenance can be carried out.

Remember exhaust gas contains carbon monoxide which is odourless, colourless and deadly poisonous. Do not run engines in enclosed areas.

For details of maintenance refer to Circular 14/75.

6. ACTIVITIES

1. List the nozzles and directors carried on your unit and describe the function of each.

2. Check your pump or pumps and under supervision of your training officer, start each unit, and go through the priming procedure.

3. Extinguish a small fire by spraying water firstly at the flames and then at the base. Satisfy yourself that the base is the correct point of aim.

6. HAZARD REDUCTION

6. HAZARD REDUCTION

1. BUSH FIRE HAZARD

Bush fires are part of the normal cycle of events in Australia; a bush fire hazard occurs where there is the possibility of fires threatening people or assets valued by people. The term assets can be taken to mean houses, crops, forests and in many cases, the environment.

2. HAZARD REDUCTION - A DEFINITION

Hazard reduction is the practice of reducing or removing fuel so as to permit the containment of a wildfire, or to minimize the damage by such a fire.

3. WHY HAZARD REDUCTION?

3.1 You will recall that there are three ways of suppressing a fire:

Remove the Fuel
Remove the Oxygen
Cool the Fire

If you consider these three options you will realise that there is only one step which can be taken before the start of the fire season - we can reduce or remove fuel.

It is not possible to change the weather and so cool the fire; it is not possible to remove all the oxygen from the atmosphere (it is not very desirable either); the only realistic move to reduce the hazard from bushfire is to reduce the fuel available to the fire.

3.2 Complete removal of fuels means that the area will no longer support fire but such a practice may be harmful to the environment. Soil erosion is one possible consequence. The more common practice is to reduce the amount of fuel, in which case we would find that a subsequent wildfire would:

(i) generate less heat and therefore be less of a danger to both fire fighters and the general public.

(ii) travel more slowly.

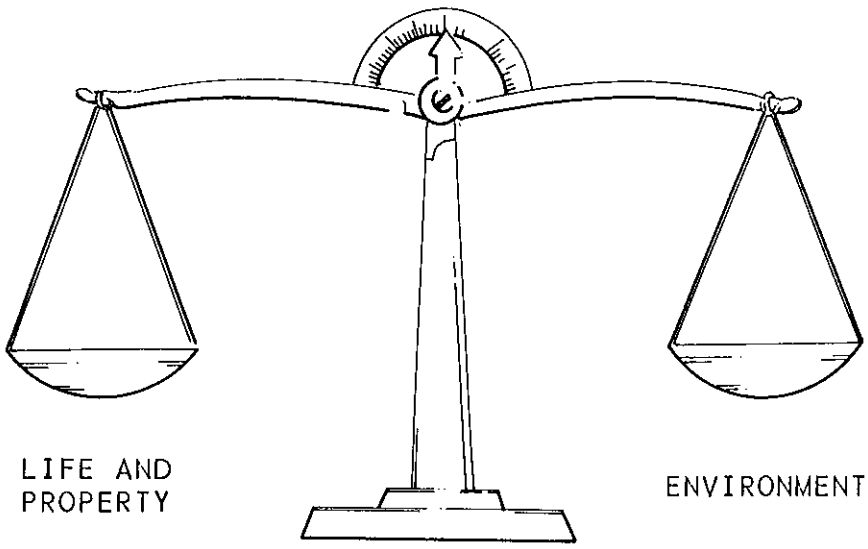
(iii) have a lower flame height and therefore be less likely to develop into a crown fire.

(iv) be less likely to spot and therefore easier to suppress.

In general, you would be confronted with a fire which could be more easily contained, as against a fire which you may not be able to contain.

4. HAZARD REDUCTION POLICY

4.1 Determining a hazard reduction policy can be complicated as different people place different values on various assets. We are not going to consider these complex policy matters here as the intention is to study the techniques available to carry out a hazard reduction policy. However, you should appreciate that the officers planning hazard reduction will be seeking to obtain a balance between people and property on the one hand and the environment on the other.



5. FUEL

5.1 Quantity

The question of hazard reduction relates to fuel quantity and location. Few people appreciate the intensity of a wildfire, and of the relationship of the intensity to the available fuel. Any examination of hazard reduction techniques means that you must have:

(a) an understanding of the relationship between fuel quantity and fire intensity.

(b) an understanding of how fuel quantities are measured.

We will now consider fuel quantity and the effect this factor has on a bush fire.

5.1.1 Forest Fuels:

(a) On a particular day of high fire risk, we could expect the following fire intensities:

Fuel Load	Fire Intensity
7.5 tonnes per ha	300 kW/m
15 tonnes per ha	1300 kW/m
30 tonnes per ha	5200 kW/m

On the above table, fire intensity is shown in kW/m which stands for kilowatts per metre

of fire front. A kilowatt is equivalent to the power of a normal single bar electric radiator. Look closely at the fire intensities. A total power output of 5200 kW/m is a tremendous amount of power and yet the same forest, with a fuel loading of 7.5 tonnes per ha, may generate only 300 kW/m.

(b) When the officers responsible for planning hazard reduction measure the amount of fuel in a forest, they do so by referring to the fuel load. This load is measured in tonnes per hectare and is determined by measuring the dry weight of litter (all material less than 10 mm diameter) on the forest floor, and the scrub foliage likely to be consumed in a low intensity prescribed burn.

Several points of interest:

(i) The ground leaf litter is measured as this is the material immediately available to the fire.

(ii) Large branches and log materials burn after the main fire front has passed and, although they contribute indirectly to fire behaviour

under drought conditions, they are not included in fuel measurement.

(iii) A shrub layer can contribute to the intensity of a fire and may, therefore, be considered when assessing available fuel.

As a guide - Five tonnes per hectare is considered to be a light fuel loading which would only carry a mild fire whilst 30 tonnes per hectare is a heavy fuel load which could support an uncontrollable wildfire. Under hot summer conditions in jarrah forests, wildfires can usually be suppressed by direct attack if fuel quantities are less than 8 tonnes per hectare. Even the best equipped suppression forces are unable to contain fires burning in heavy fuels.

5.1.2 Grassland Fuels:

(a) On a particular day of high fire risk, we could expect that a fire in sparse, fully-cured grass would result in a fire with a flame height of 2 metres, whereas a fire in heavy pasture, on a similar day, would result in a fire with a flame height of 7 metres.

(b) Grassland fuels are not measured by weight but are estimated by using the following criteria:

(i) degree of curing - ranging from green (non-flammable) grass to fully cured (highly flammable) grass.

(ii) density of grass - that is, sparse, average or heavy pasture.

5.2 Location

We have discussed the effect of fuel quantity; the other factor which must be considered when planning hazard reduction is that of fuel location. Remember that dense fuels are not necessarily a problem for they must be where they can endanger life or property. The two main points to consider are:

(i) terrain - slope and aspect

(ii) wind direction.

5.2.1 Remember that fires accelerate as they travel uphill, so particular attention must be paid to areas such as ridge-top housing developments.

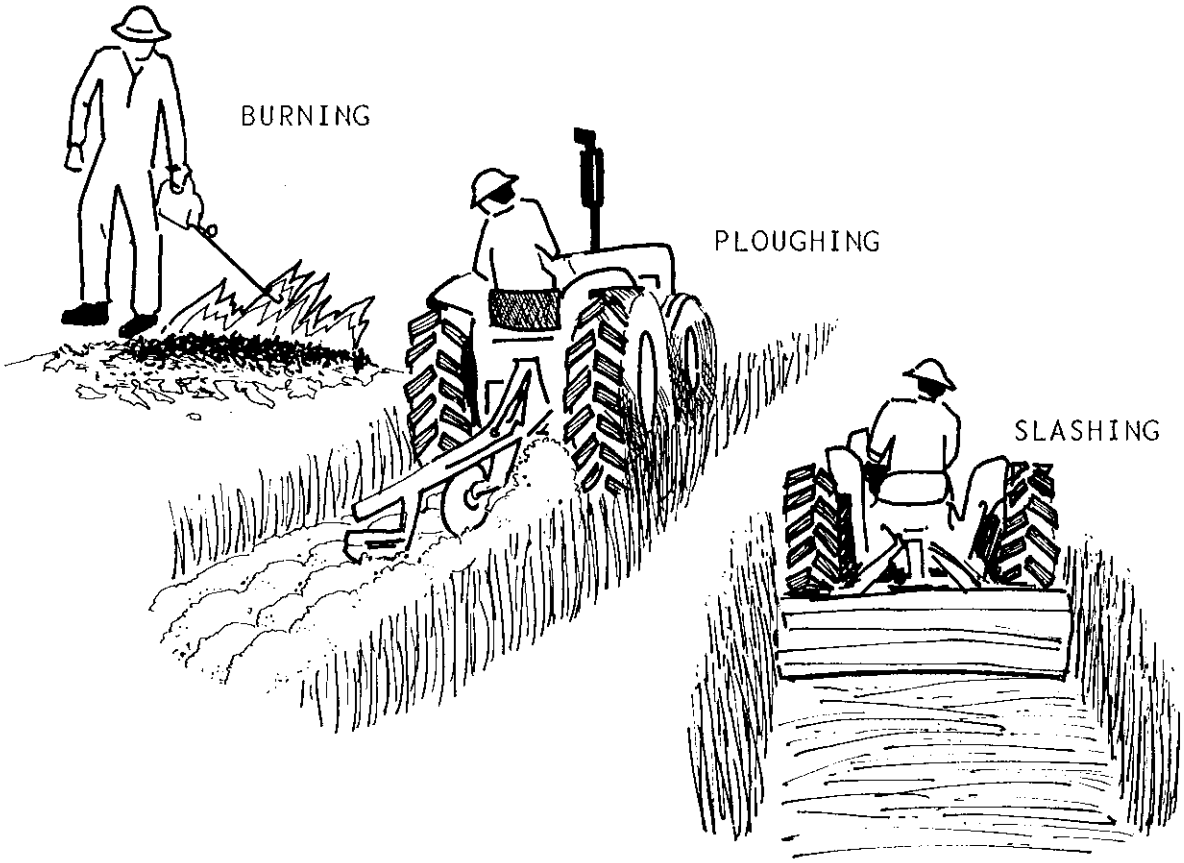
5.2.2 Be aware of the direction of winds which have previously caused the greatest threat during bushfires. You can predict, with a reasonable degree of certainty, the direction of most intense activity of a bush fire.

5.2.3 Combining the effects of terrain and winds, in W.A., the most potentially dangerous areas are generally on sloping land facing the North-West.

6. METHODS OF HAZARD REDUCTION

6.1 There are many individual techniques of hazard reduction but we can identify three basic methods.

6.1.1 Burning is known as "prescribed" burning. This is the most common form of hazard reduction and is covered in No. 7.



6.1.2 Slashing is a general term used to cover any process whereby fuel is cut and either left on the ground or removed. When retaining the fuel, it may be cut at the base and left as is, or it may be "mulched" so that it packs down and so burns more slowly. Why will it burn more slowly if cut or mulched? Refer back to Section 2 - Fire Behaviour and consider the section on fuel arrangement.

6.1.3 Ploughing is a common method of constructing fire breaks in grass lands and can be a most effective means of preventing the spread of fire.

7. IMPLEMENTING PRESCRIBED BURNING

7.1 Planning

Prescribed burning aims to reduce the amount of fuel so that fires can be controlled under all weather conditions. It may be defined as a deliberate use of fire restricted to a pre-determined area and intensity.

The degree to which fuel reduction is necessary depends upon the amount of fuel accumulation acceptable. Generally, direct attacks on fires will fail in extreme weather conditions where jarrah forest fuels exceed 8 tonnes per hectare.

The rate at which fuels accumulate varies considerably. Frequency of prescribed burning depends upon the rate at which fuel accumulates and should not be tied to an arbitrary interval for burning, e.g., every 4, 5, 10 years etc.

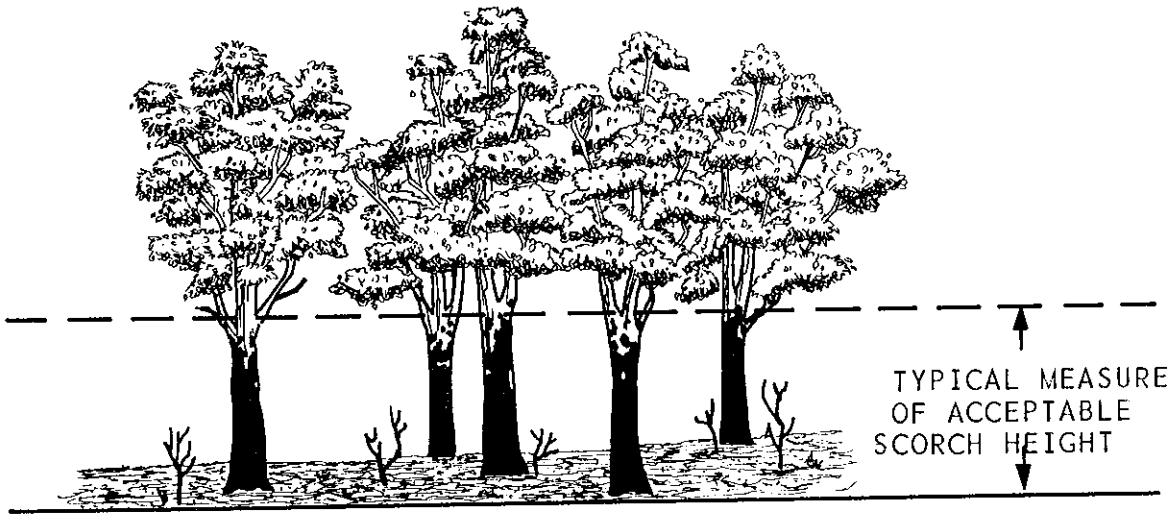
Any planned burning is carried out for specific reasons and those reasons will form a "prescription" for the way in which the work is carried out. The major reason for burning is to provide protection to specific assets from the ravages of bushfires. This can be achieved by either reducing fuels over large areas (broad-area hazard reduction), or reducing fuel in strategic locations. In either case it is important to set down the specific aims of the burn which include:

(a) The percentage of total area to be burnt out.
(b) The maximum acceptable height of tree scorch.
(c) The acceptable cost per hectare for burning.

To be effective as a wildfire buffer, a planned burn should cover at least 60 percent of the area. Fires burning under severe conditions are able to readily burn through low fuel buffers which have more than 40 percent of their area unburnt.

Research has shown that scorch height is directly related to flame height and fire intensity. The acceptable scorch height will depend on the fire resistance of the tree species and the height of the forest canopy.

Burns carried out in Autumn will normally result in higher scorch than a similar intensity burn done in Spring.



In summary it is usual to aim to achieve an inexpensive burn which covers at least 60 percent of the burn area with a minimum of crown scorch (say 9 metres).

7.2 Assessment and Prescription

Fuels on areas to be burnt under prescription should be carefully assessed to obtain data on which the detailed prescription is based. Fuel assessment is based on a random sampling of litter depth, trash height, scrub density and height.

7.3 Prescribed Burning Methods

7.3.1 General Provisions

An area prescribed for burning must be enclosed by natural or constructed breaks within which the burn can be contained.

The area programmed should be completed in one day except where multiple lightings have been prescribed. No fire should be running out of control on the second day even "inside" the burn.

In all circumstances, the down-wind edge must be safe before proceeding with the remainder of the burn. Edge burning may be carried out to strengthen the boundaries of a burn.

7.3.2 Edging

To ensure containment of the burn and to reduce the time spent on mop-up and patrol, edging of large blocks should be carried out in late autumn,

winter and early spring, when subsequent weather will not allow the edge burn to re-ignite and continue running. Re-ignition is unlikely and edging is reasonably safe while fuels are moist.

Good quality edging will greatly assist in determining the success of the prescribed burn by:

(a) reducing the need for costly mop-up and patrol activities.

(b) reducing the risk of escape from subsequent flare-up in unburnt pockets as conditions dry over summer.

Effective edging with minimal scorch can only be regularly achieved if this activity is planned and prescribed for with the same thoroughness as the actual burn.

7.3.3 Burning Across the Wind (Head Fire Burning)

The method of burning across the wind, commonly called stripping, is to start from the down-wind edge of the area to be burnt by lighting spot fires on lines at right angles to the wind direction.

Spot fires are lit in lines and it is normal

practice to have the lines twice as far apart as the spot fires, since the fire from each spot moves approximately twice as fast between lines (head fire) as it does between spot fires (flank fire). For example, if the lines are 200 metres apart, spots should be 100 metres apart. The spot fires should be spaced far enough apart to enable the individual fires to eventually join up during the cool of evening to avoid excessive scorch from junction zones between fires. The spacing can be determined by the product of the rate of spread and the hours of burning time available. Adjustment of spacing will be necessary during the day.

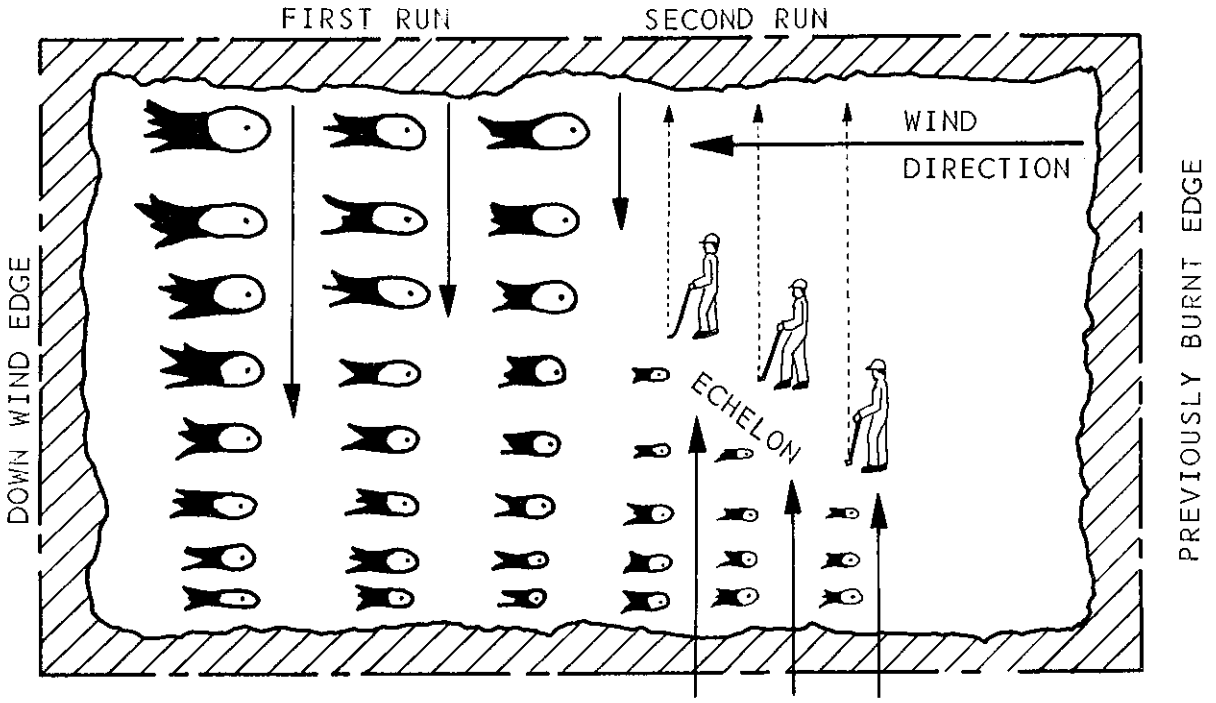


Figure 1 - shows the method of lighting, using echelon formation.

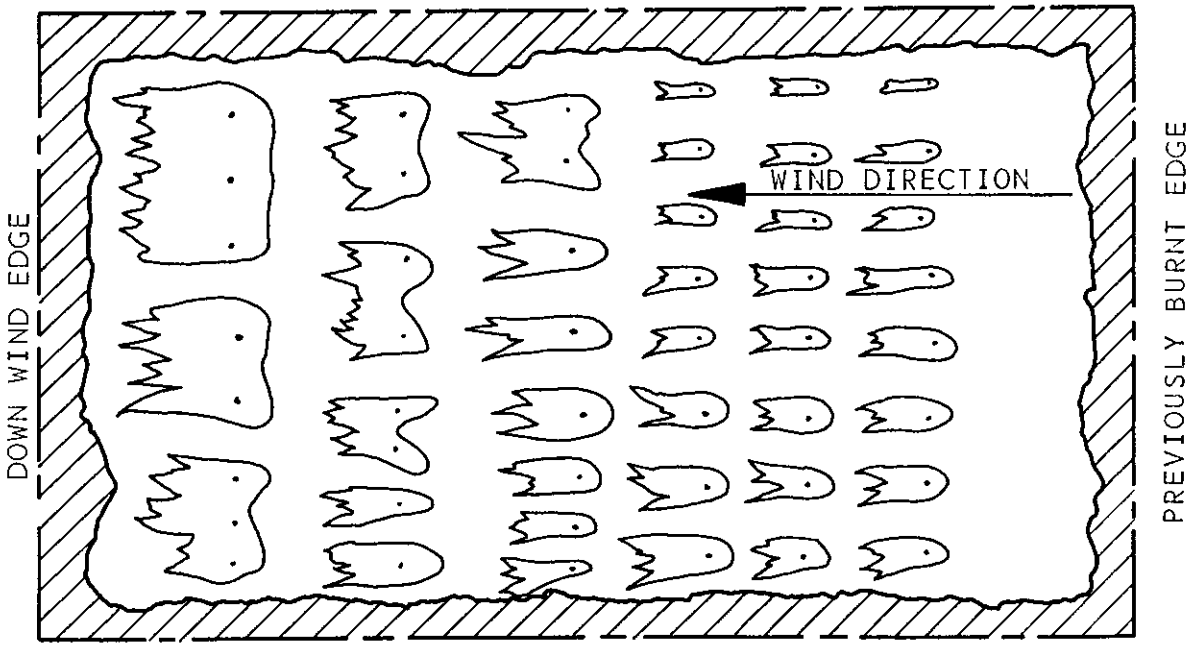


Figure 2 - shows the ideal distribution of fire after lighting.

Lighting should commence as soon as the ignition points will maintain themselves.

Burning across the wind normally assumes that the lighters are widely spread, with the fire taking some hours of travel between lines of spot fires. The general features of this type of burning are:

The lighters are free of smoke and are in no danger from fires lit by another lighter crossing their path. Lighters must not lose their echelon formation and walk ahead of those down wind.

Alternate runs are in opposite directions ensuring minimum loss of time.

Should it be found that acceptable scorch heights are going to be exceeded, or for any other reason it may be necessary to cease burning, the last line of fire becomes a back-fire once the spots have joined. This will give control of the fire and simplify suppression.

Cross wind burning results in most of the burning being done by the headfire. Since headfires give maximum rate of spread, this method achieves the desired result in the shortest time.

Where there is unpredicted change in wind direction:

If the change is not associated with an increase in strength, fire danger will not be increased and scorch height will remain the same.

If the change is associated with increased wind strength, men must be withdrawn and additional suppression forces alerted if necessary.

A change in wind direction up to 90 degrees does not materially affect control or safety, whereas a change of more than 90 degrees will affect both.

8. SAFETY

Safety must be stressed whenever burning is in progress. Do not underestimate risks when conditions are mild. The number of lighters should never exceed six.

The officer directly in charge of lighting must brief all members of the crew before lighting commences. He must ensure that each man knows exactly what is to be done.

All personnel must be familiar with:

The area to be burnt, which should be shown on a plan and indicated on the ground.

The roads and tracks in the vicinity, and their point of outlet.

Features such as swamps, creeks and steep slopes.

Wind direction and the likelihood of changes.

Direction of strip lines and the formation to be used.

Spacing and placing of men in the formation.

Action to be taken by individuals if they lose contact with others.

The officer in charge must place his most experienced and competent men at each end of the formation. It is the responsibility of everyone to ensure that the instructions are understood. Never give the impression that instructions have been understood if in fact they have not.

If unexpected conditions such as increases in wind or fuel arise, STOP LIGHTING and move out the path of the fire, i.e., up-wind or down-slope of your position.

Planning and supervising a prescribed burn is a complex task which should only be carried out by responsible fire officers. It is essential that fire fighters obey all directions promptly and co-operate as a team so that the burn is carried out safely and effectively.

7. BASIC COMMUNICATIONS

7. BASIC COMMUNICATIONS

1. Effective communication is the very heart of efficient fire suppression. Radio communication, in particular, is vital and all bush fire fighters must be able to use a two-way radio in a clear, concise manner. This module is intended as an introduction to the use of radio communication with particular attention to:

   (a) the regulation governing the use of radio communication.
   (b) the type of radio networks used in bush fire control.

   (c) the various controls and adjustments on typical two-way radios.
   (d) correct procedures for using two-way radios.
   (e) standard phrases and pro-words.
   (f) care and basic maintenance of radio communication equipment.

2. DIFFERENT TERMS

   A transmitter/receiver may also be known as a transceiver or two-way radio.

   A portable transmitter/receiver may also be known as a walkie-talkie or handphone.

3. REGULATIONS

All radio transmitter/receivers are licensed by the Department of Communications and the licences are issued for particular frequencies. It is illegal to operate a transmitter/receiver without a licence for that particular frequency.

4. NETWORKS

The Department's radio communications systems contain three types of radio networks.

4.1 HFSSB - (High Frequency Single Side Band)

These are used to communicate over great distances from vehicle to vehicle, or office to vehicle.

4.2 Very High Frequency (VHF) - Low Band

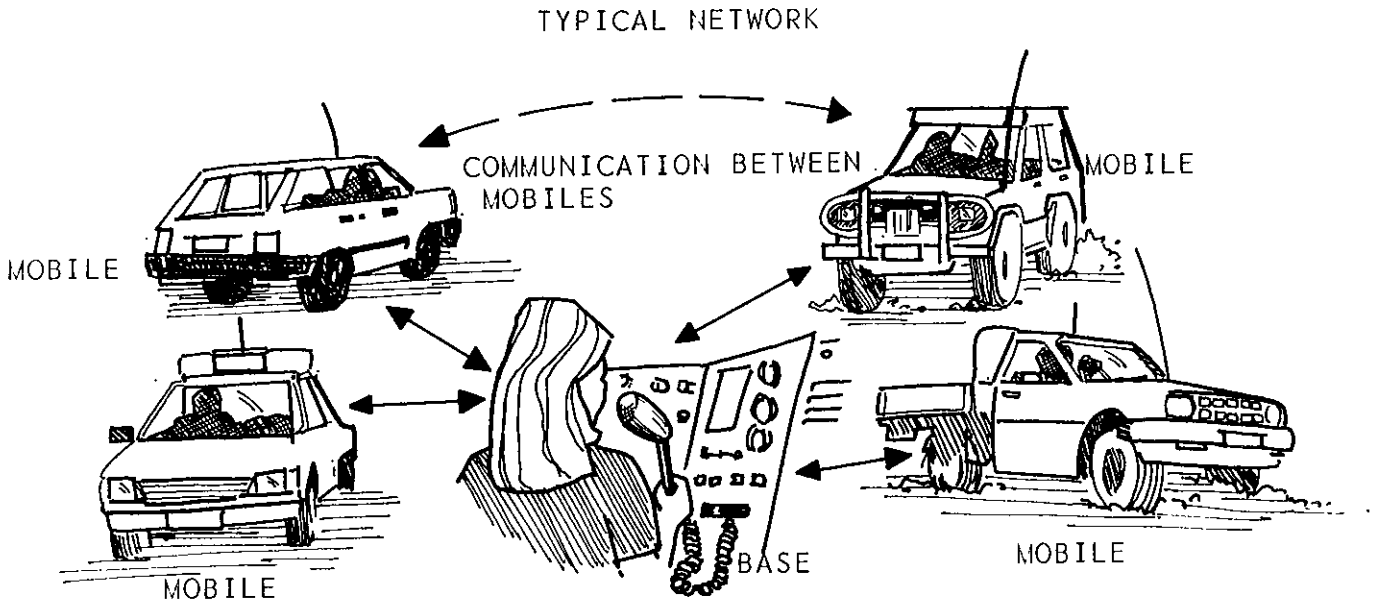
These are used for inter-District mobile communications for distances up to 50 kilometres. This is the most common radio network used to communicate from vehicle to vehicle, office to vehicle, office to aircraft, or vehicle to aircraft.

4.3 Very High Frequency (VHF) - High Band

These were formerly referred to as "RT Network". These are used for inter-District communications between towers, aircraft and offices, and used exclusively for fire detection communications.

4.4 In a typical District, we would expect to find:

(a) One base station consisting of a fixed transmitter/receiver that provides for communications throughout the District.



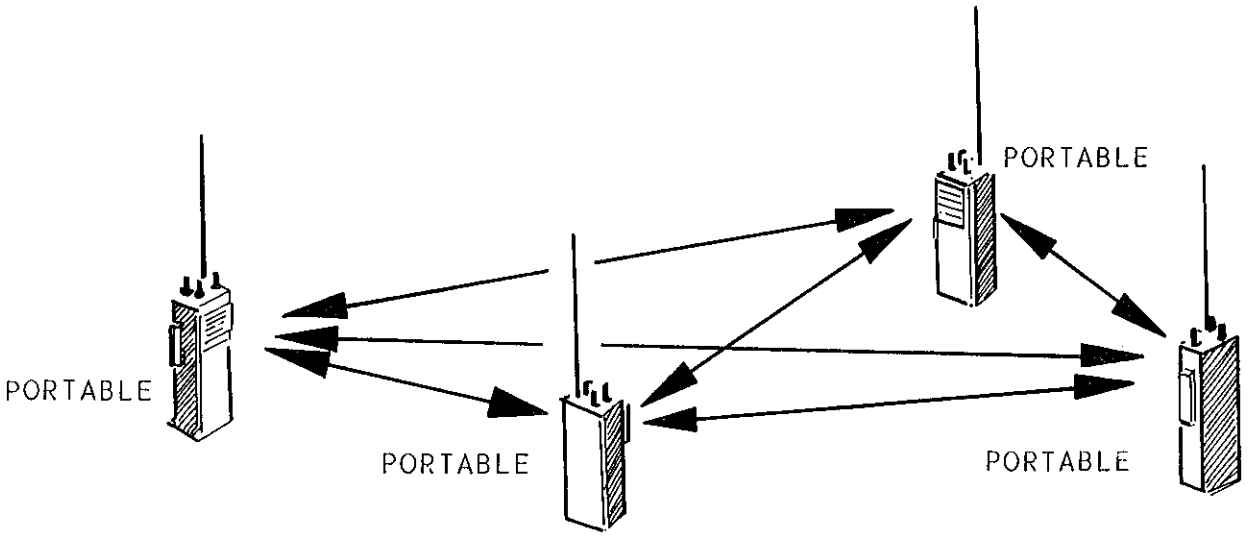
(b) A number of mobile transmitter/receivers fitted to vehicles responding to the base station.

(c) Portable hand-held transmitter/receivers (often referred to as walkie-talkies).

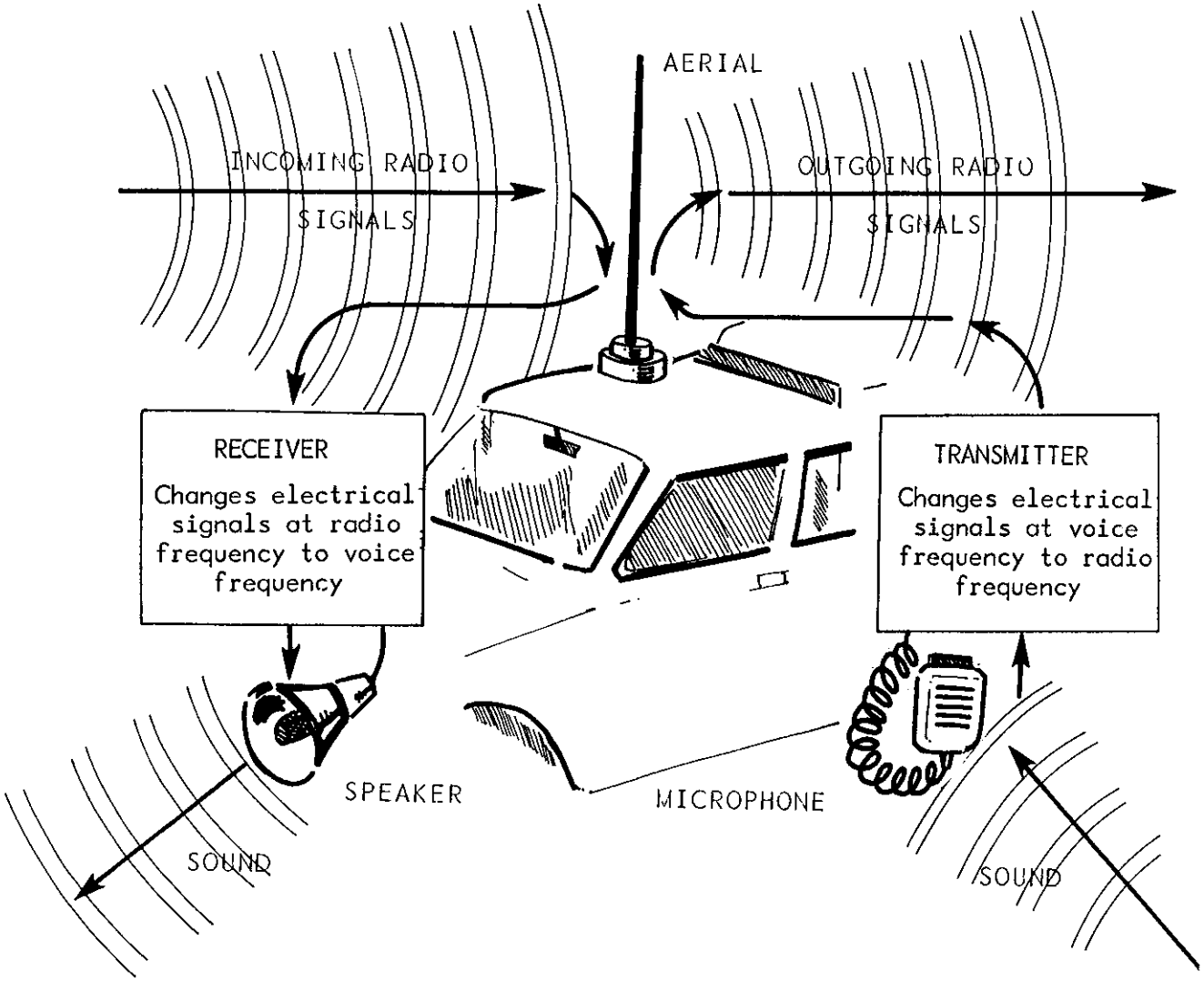
5. PRINCIPLE OF TRANSCEIVER OPERATION

Before considering the correct usage of a transceiver (transmitter/receiver), let us look at the basic principle of a typical unit.

Study the following diagram:



TYPICAL NETWORK



Note: It is important to remember that the transmitting and receiving sections of the unit are interconnected so that they cannot both operate at the same time. This is done by means of a change-over switch on the microphone. When you

press the microphone switch, you automatically disconnect the receiver.

6. AERIALS

Each aerial is matched it its transceiver and failure to use the aerial as directed by the manufacturers will result in poor communication.

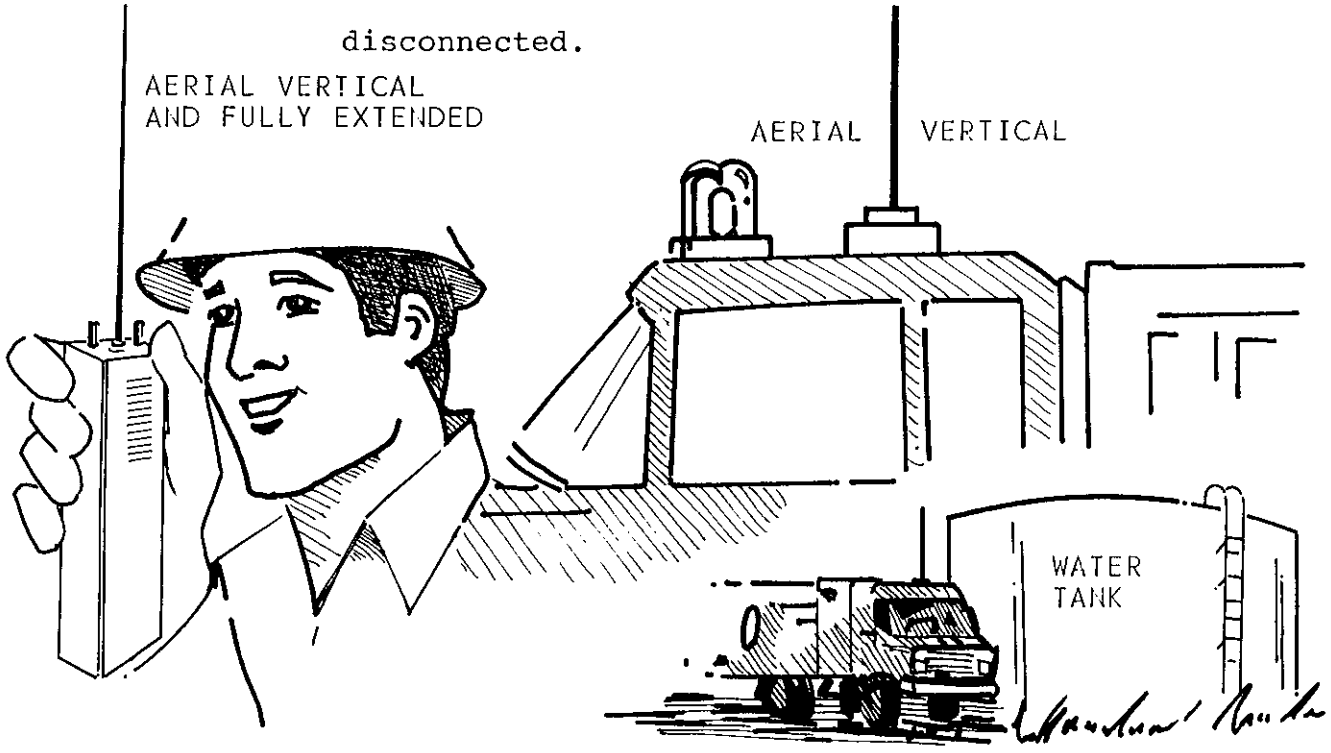
A few simple rules:

(a) Always ensure that the aerial is fully extended.

(b) Make sure that it is vertical, particularly in the case of hand-held units as there is a tendency to lay the unit over. Keep it upright.

(c) Avoid large metallic objects and parking under trees as these tend to weaken or distort the signal.

(d) Do not transmit if the aerial is broken or disconnected.



AVOID SUCH LOCATIONS

7. MICROPHONE

The microphone is a sensitive piece of equipment which converts sound waves into an electrical signal. It is important to observe a few simple rules for clear undistorted transmission:

7.1 (a) Speak across the microphone and not directly into it. Speaking directly into the microphone may cause distortion.

(b) Keep the microphone a constant distance from you so that it gives a consistent signal.

7.2 The best way to ensure correct usage of the microphone is to touch your cheek with your thumb and lightly hold this position so that if your head moves you will still maintain the critical relationship between your lips and microphone.

CAUTION: Remember that your transmitter is activated whenever you push the microphone switch. Keep your transmission to the minimum. Remember also that when you press your microphone button you "jam" the network so that no-one else can transmit.

8. TRANSMISSION RANGE

There are two types of radio equipment used for primary networks:

(a) H.F.S.S.B. - (High Frequency Single Side Band).

(b) V.H.F.-F.M. - (Very High Frequency - Frequency Modulated).

8.1 H.F.S.S.B. is used in sparsely populated areas as it has an extensive range - under good conditions. The transmission is, however, easily upset by thunderstorms and reception will vary with changes in atmospheric conditions, for example, between night and day. S.S.B. transmission can even be affected by distant radio signals, but, it is the answer when we are called upon to provide radio coverage over large areas.

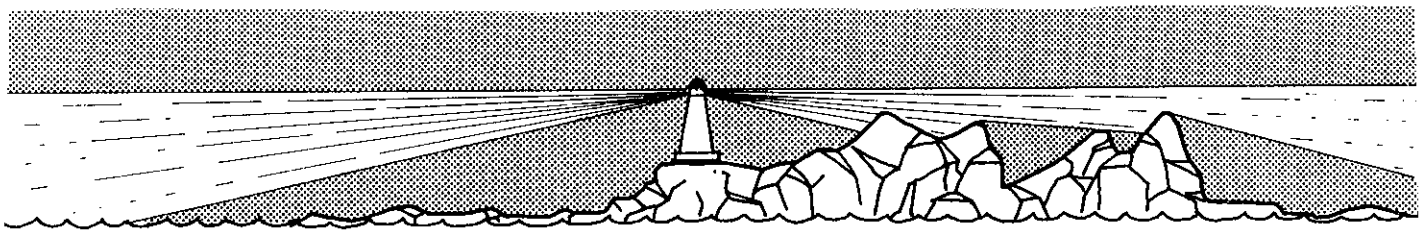
8.2 V.H.F.-F.M. is by far the most common network equipment for communication within Districts. It has a range of up to 50 kilometres. This equipment is relatively inexpensive, reliable, and free from atmospheric interference. There is, however, one major problem and

that is that the transmission travels in a straight line. This poses problems in mountainous country and it is often necessary to move a mobile to higher ground in order to communicate with the base. V.H.F.-F.M. has the advantage that it allows good, clear quality of communication.

Imagine a lighthouse:

(a) the further from the lighthouse, the weaker the light.

(b) the light can be broken by obstacles.



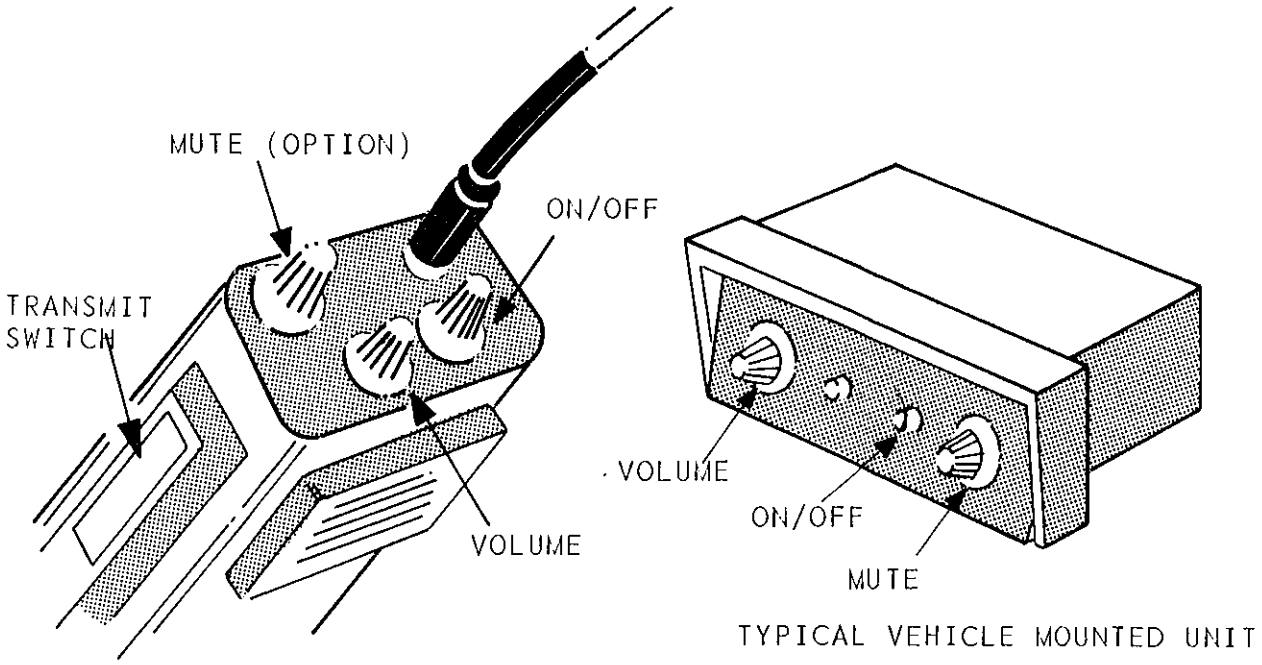
Obviously then, both the distance between the transmitter and receiver and the relative location of each unit will determine the signal strength. You can expect one of two effects if either of these factors are unsatisfactory:

(a) If stationary, and the signal is weak, either move the mobile closer to the base or seek a more elevated location.

(b) If moving, the signal may "break-up" - that is, you will receive parts of the transmission. Stop, preferably on the crest of a hill, and try several locations until you receive a clear, unbroken signal.

9. CONTROLS

Manufacturers adopt different designs for their equipment but all transceivers used in the Department have certain standard controls. The following diagrams show a typical vehicle-mounted unit and a typical portable unit.



TYPICAL VEHICLE MOUNTED UNIT

9.1 ON/OFF SWITCH. The use of this switch is self-explanatory, it simply controls the electrical power to the transceiver. Do not leave transceivers switched on when not in use as they will still consume power and may eventually drain the battery.

9.2 VOLUME CONTROL. The volume control controls the output volume of the receiver. Transmitter output is fixed and is not adjustable by the operator.

9.3 MUTE, SQUELCH OR NOISE CONTROL. Different names for the same control. Limits the sensitivity of the receiver to input noise.

To adjust, turn mute fully "OFF" - generally full rotation of knob anti-clockwise - a strong background noise should be audible.

Turn mute fully "ON" - generally full clockwise rotation - no background noise - receiver quiet.

Rotate "MUTE" control towards full "OFF" position until background noise heard. Reverse fractionally until the noise ceases. It may be necessary to re-adjust the mute control from time to time. Do not use "Mute" control as a "Volume" control.

9.4 CHANNEL SELECTOR. There are several versions of Channel Selector currently in use, e.g. rotary locking, rotary electronic, push-buttion. Channel of operation is set by the District or Region.

10. PROCEDURE

Effective communication relies on messages being:

(a) concise.

(b) clear.

10.1 We can keep our messages concise by carefully considering what is to be said before beginning to transmit, and by limiting our message to essential information. Do not engage in lengthy conversation as other operators may be waiting to use the network. You must be familiar with the following words -

10.2 Affirmative	Means	'Yes' or 'Correct' or 'That is Correct' or 'I agree'.
Negative	Means	'No' or 'That is incorrect' or 'Permission not granted'.
Clear	Means	'End of my transmission - no answer required or expected' or 'The wave is clear and available for traffic'.

Over	Means	'End of my transmission - a reply is expected'.
Roger	Means	'Message received and understood'.
Wilco	Means	'Message received, understood and I will comply'.
Say Again	Means	'Say again all (or portion indicated) of your last transmission'.

10.3 We can ensure that our messages are clear by speaking correctly and, if necessary, spelling out our message with the help of the phonetic alphabet. Under normal circumstances, correct voice procedure is sufficient to ensure good communication.

Rhythm:

(a) Speak naturally and with normal rhythm. Your message should be spoken in complete phrases that make sense and not word by word, e.g.,

"Water tanks will be brought up/as soon as the stubble paddock is burnt."

Not

"Water tanks will be/brought up as/soon as the stubble paddock is burnt."

Not

"Water/tanks/will/be/brought/up as/soon/as/the/stubble/paddock/is/burnt."

(b) Care must be taken not to say "er" after a word or to insert it between phrases.

Speed:

(a) Talk steadily at medium speed. If you speak too fast your speech will be received as an unintelligible jumble of words. If you speak too slowly you will waste time and exasperate the recipient.

(b) The speed must be constant throughout.

(c) The less important words must not be hurried.

(d) If the message has to be written down the pauses between phrases must be longer.

Volume:

(a) You must talk louder than in ordinary conversation but not shout.

(b) In ordinary conversation the important words are stressed while the less important words receive less emphasis. This practice must be avoided. Every word must be spoken equally loudly and the voice must not be allowed to fade away on the last word.

(c) The mouth must be close to the microphone and kept at this distance constantly. If the head is turned away from the microphone while speaking, the volume of speech received at the other end will drop and the words may become lost.

Pitch:

High-pitched voices are often transmitted more successfully than those of a lower pitch. The voice must be pitched higher than usual, but there should be no discomfort. In normal conversation, the voice is allowed to drop in pitch on the last syllable of each word and on the last word in each phrase. This must be avoided in radio communication and can be achieved by maintaining the pitch at the end of each word or phrase and by not dropping the voice at the end of a sentence.

10.4 In framing sentences, short and easily recognised words of one or two syllables should be used. Words liable to cause confusion should be spelt - e.g., weather, wether, whether. Whenever it is necessary to use letters they will be spoken as set down in the phonetic alphabet.

When it is difficult for people to understand transmission, or you have a vital section of a message to send, you can reinforce your transmission by spelling out words with the use of the phonetic alphabet.

This is a set of words, adopted on an International basis, which clearly identify a specific letter of the alphabet. To use the phonetic alphabet, first say the complete word and then spell it out, for example -

"PUMPS, I spell Papa Uniform Mike Papa Sierra"

A copy of the phonetic alphabet has been included at the end of this section for your reference.

11. CALL SIGNS

Each transceiver in a network is given a call sign and this call sign must be used at all times. A properly organized communications network will include written identification of the call sign on each transceiver. Make sure you know the correct call sign before you send or receive a message. Typical call signs are:

District Office	6 DE Harvey
OI/C	Harvey One
Mobile	Engineering Four
"	Inventory Eight
"	Wanneroo Three Four

12. TO RECEIVE A MESSAGE

When receiving a message, you will obviously be replying to someone calling your station. Answer as follows:

(a) Give the call sign of the station calling you.

(b) Give your call sign.

(c) State go ahead.

Example: You receive a call "Harvey Four From 6DE Harvey."

You reply "Harvey Four - go ahead."

This will acknowledge to the calling station that you are able to hear them and that you are prepared to take their message.

13. TO SEND A MESSAGE

Firstly, think carefully about who you are calling and what you wish to say. Your transmission must be clear and concise.

The steps for sending a message are:

(a) Give the call sign of the station being called.

(b) Give your call sign.

(c) Follow with the pro-word 'over'.

(d) The station being called will acknowledge and advise 'go ahead'.

(e) Repeat the call sign of the station being called.

(f) Give your call sign.

(g) State your message.

(h) Finish with the pro-word 'over' if you require acknowledgement or further transmission; finish with the pro-word 'clear' if you have finished and do not require further transmission.

Example: "6 DE Harvey from Harvey Four"
"Harvey - go ahead"
"What is pump status - over".

It is illegal to include obscene language in any message.

14. EMERGENCY

The word emergency is only to be used in cases of extreme urgency where the safety of a person or persons is at stake. Commence transmission immediately; repeat the word emergency and all other stations with cease transmission until you have concluded your communication. Similarly, upon hearing the call 'emergency' you are to cease transmission and to listen to the communication. The only time that a mobile would answer such a call is if you are the only operator in a position to take the message, in which case you would serve as a relay to the base.

15. CARE AND MAINTENANCE

(a) Transceivers should be handled with care as they are expensive and can be damaged if handled carelessly.

(b) Keep transceivers out of direct sunlight and protected from water and chemicals.

(c) Transceivers should only be serviced by authorised technicians. They are sophisticated items of equipment which can be damaged by incorrect servicing.

(d) Batteries fitted in portable units should be checked at regular intervals and changed as required. Always use 'leakproof' batteries in transceivers as the chemicals leaking from batteries can ruin electronic components. Always use Alkaline batteries, as they have a much greater capacity than standard batteries.

16. ACTIVITIES

Practice. The only way to become competent at communication techniques is to practice at every available opportunity.

Practice (a) receiving messages correctly
(b) transmitting messages correctly, and
(c) relaying messages correctly.

The best form of practice is to use an actual transceiver, but there are limitations to the time available for such training, and you should take the time, whenever possible, to consider how you would make a particular statement if using a transceiver. If possible, practice with a tape recorder so that you can check your performance and become proficient.

Failure to use correct procedures at a fire will not only leave you in a difficult position, but may jeopardise the safety of persons on the fire line.

PHONETIC ALPHABET

LETTER	WORD	APPROXIMATE PRONUNCIATION
A	Alpha	Al-fah
B	Bravo	Brah-voh
C	Charlie	Char-lee
D	Delta	Dell-tah
E	Echo	Eck-oh
F	Foxtrot	Foks-trot
G	Golf	Golf
H	Hotel	Hoh-tel
I	India	In-dee-ah
J	Juliett	Jew-lee-ett
K	Kilo	Kee-loh
L	Lima	Lee-mah
M	Mike	Mike
N	November	No-vem-ber
O	Oscar	Oss-cah
P	Papa	Pah-pah
Q	Quebec	Key-beck
R	Romeo	Row-me-oh
S	Sierra	See-air-ah
T	Tango	Tang-go
U	Uniform	You-nee-form
V	Victor	Vik-tah
W	Whiskey	Wiss-key
X	X-ray	Ecks-ray
Y	Yankee	Yang-key
Z	Zulu	Zoo-loo

8. BASIC FIRST AID

8. BASIC FIRST AID

1. Safe working practices are the main theme throughout this training programme but, despite our best efforts, accidents occur.

In view of this, every bush fire fighter must know:

(1) How to support life until qualified help is available.

(2) How to minimise the trauma (the term to describe the condition of the body as a result of a wound or external violence) to an injured person until qualified help is available.

This is not intended as a course which will give you any formal qualification in First-Aid. Any person wishing to become qualified in this field should contact either the St John Ambulance Association or the Red Cross. However, whilst any form of medical assistance is a task for the qualified person, we should all be able to carry out the basic steps required to support life and minimise trauma; it may take some time for help to arrive.

2. THE ESSENTIAL RULES OF FIRST AID

2.1 Rapidly and accurately assess the whole situation, and allocate a priority of assistance. Deal with the most important things first; if the victim is in danger from

the surroundings (despite any injury) it may be necessary to remove him - or remove the threat.

Consider the case of an injured person in the path of an oncoming fire: consider the case of a person trapped by a fallen power line.

A note of caution: Consider your own position, as well. Think carefully, for instance, before attempting to drag victims away from fallen power lines if they are still in contact with "live" wires.

2.2 Check the victims airway and breathing. If the victim is having difficulty breathing, check the airways and adjust the body to make breathing easier. If the victim is not breathing, check the airways and commence breathing for the victim, that is, carry out Expired Air Resuscitation (E.A.R.).

2.3 Check the victim's circulation. If there is no pulse, commence pumping blood through the system, that is, carry out External Cardiac Compression (E.C.C.).

2.4 Determine level of consciousness. If unconscious, but breathing, move to recovery position, as described later in this section. A conscious victim will usually adopt the most comfortable position and this position

should not be altered without valid reason. It may be desirable to help the victim into a more comfortable position to ease pain and control shock.

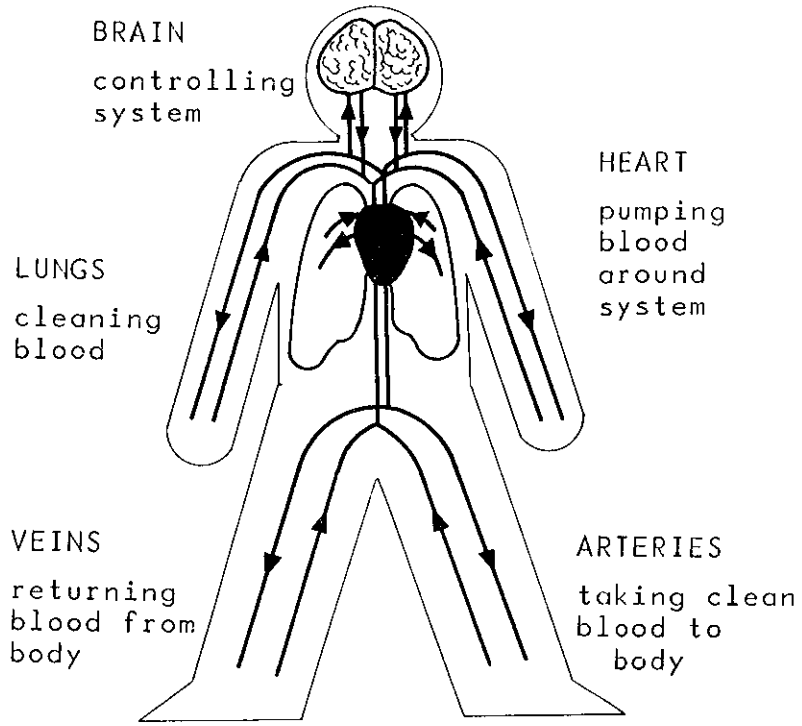
2.5 Control haemorrhage (bleeding). Any life threatening bleeding demands prompt attention as it can jeopardise life. Remember that any loss of body fluid will aggravate shock and must be controlled as soon as possible.

2.6 Do not remove clothing unnecessarily. Light clothing may be loosened for comfort but it is desirable to keep a person covered to maintain body temperature. If clothing must be removed, to expose injuries, it should be done with a minimum of disturbance to the person and minimum damage to clothing.

2.7 Do not attempt to give an unconscious victim any food or drink. Do not give anything to any person who obviously requires urgent medical or surgical attention.

3. THE HUMAN BODY

The human body is extremely complicated but we can understand the basic requirements for sustaining life if we consider the body to be like a simple machine.



We can now refer to:

(a) the Essential Rules of First Aid, and

(b) the diagram of the human body, and consider individual methods giving assistance to injured persons.

4. AIRWAY AND BREATHING (E.A.R. - Expired Air Resuscitation)

The first step in assisting an injured person is to check that they are able to breathe correctly. Remember that the lungs supply oxygen to the blood and that without this oxygen the cells in the body will break down, resulting in the death of the victim. Check that the victim is <u>able</u> to

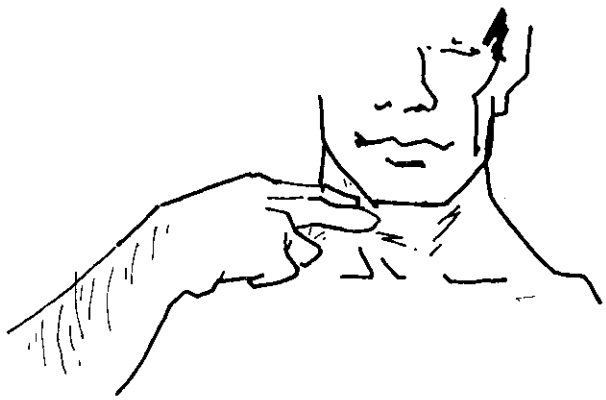
breathe, in other words, are the airways clear? If the victim is not breathing, check the airway and begin Expired Air Resuscitation (E.A.R.). Expired Air Resuscitation is a simple process of inhaling air into your lungs and of then breathing that air into the victim's lungs. There is sufficient oxygen in the air that you breathe out to resuscitate the victim.

We will not go into the actual technique in this module as there are many very good publications which have been produced in the public interest. You should obtain one of these. Sufficient to say that you should first check the airways, then check breathing.

5. CIRCULATION

The second step is to check that the victim's heart is operating correctly and hence pumping blood through the system. Blood flow is essential as the brain in particular will start to deteriorate after 3-4 minutes without a flow of fresh blood. Correct operation of the heart is checked, of course, by feeling the "pulse" which is the pressure increase felt in the arteries when the heart pumps. Where possible, feel the carotoid pulse on the neck. If the victim's heart has ceased to pump, commence External Cardiac Compression. External Cardiac Compression is used in conjunction with Expired Air Resuscitation and publications which illustrate one will also cover the other.

The two procedures, together, are known as Cardiopulmonary Resuscitation; a rather long medical term which is commonly abbreviated to CPR.



6. D.R.A.B.C.

A good way to jog your memory when arriving at an accident scene is to think of the D.R.A.B.C. of first aid.

D.	DANGER	Check for danger.
R.	RESPONSE	Check patient response.
A.	AIRWAY	Check if airway clear.
B.	BREATHING	Check if breathing present.
C.	CIRCULATION	Check if circulation present.

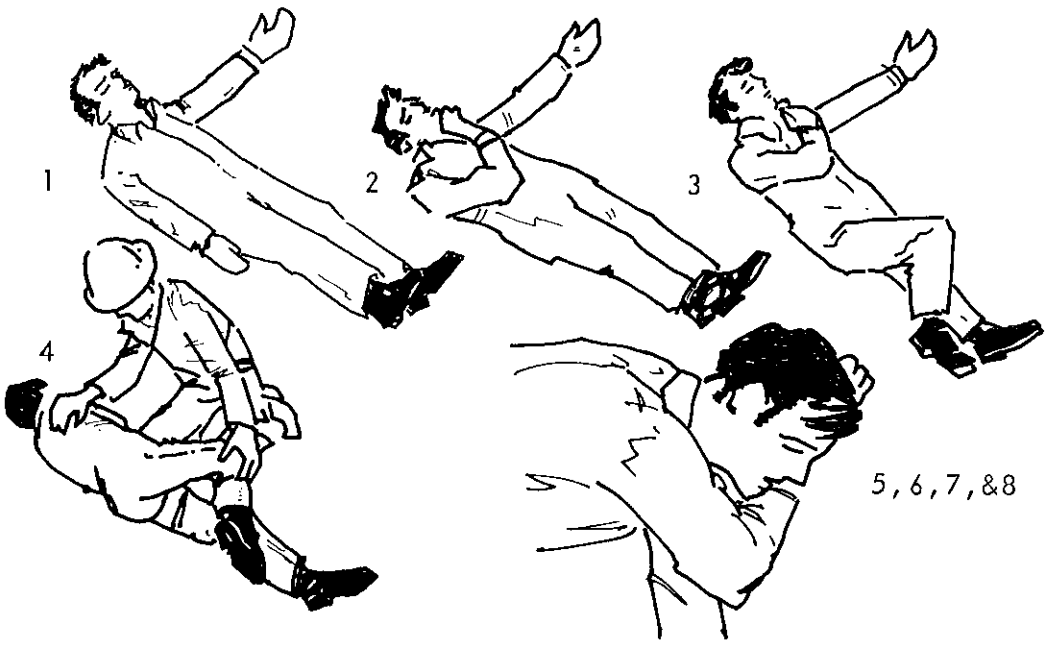
7. CARE OF THE UNCONSCIOUS VICTIM

Once we are satisfied that the victim is breathing and that a pulse is present, an unconscious victim should be placed

in the Coma or Recovery Position. This is done, of course, having due regard to injuries. The recovery position has the following advantages.

(a) The danger of the airway being blocked by either the tongue falling back or vomitos, blood and secretions, is minimised.

(b) The victim is both stable and comfortable in this position.



8. TO PLACE A VICTIM IN THE RECOVERY POSITION

8.1 With a victim lying on back:

(1) The victim's left arm is extended at 90 degrees from the body.

(2) The victim's right arm is placed across the chest.

(3) The victim's right knee is bent to bring the upper leg at right angles to the hip and to keep the left leg straight. If assistance is available, they can support the head and maintain a clear airway.

(4) Kneel near the victim's side and roll the victim to the left side grasping his right knee and shoulder.

(5) The victim's right arm is placed across the left arm approximately at the left elbow.

(6) The victim's head is held in the position of maximum backward tilt with the jaw supported.

(7) If necessary the head may be supported in the palm of the right hand.

(8) The face is turned slightly downward to permit drainage of saliva.

Note: Continually observe an unconscious victim so that you can tell qualified assistance of any changes in condition.

9. HAEMORRHAGE (Bleeding)

Refer back to the diagram of the human system. Blood is the life fluid of the system as it continually cleans and renews the cells in the body. Any appreciable loss of blood will mean that the system may start to fail; excessive loss of blood will result in death.

Observe that, in the diagram, blood is carried through two types of channels. The arteries take blood from the heart to the system whilst veins return the blood to the heart. It is important to be able to distinguish between bleeding from arteries and bleeding from veins.

9.1 Bleeding from arteries:

(i) Blood is bright red in colour as it has been cleaned by the lungs.

(ii) It tends to spurt from wounds as it is being directly pumped from the heart.

9.2 Bleeding from veins:

(i) Blood is a dark colour as it is full of impurities from the body.

(ii) It tends to flow slowly from wounds as it is returning through many veins to the heart.

be able to tell qualified persons of the exact time of application.

(ii) Do not attempt to clean the severed ends or interfere with the tissues in any way.

(iii) Place the severed part in a plastic bag (plastic food storage bag) and then again in a second bag containing cold water which could include ice cubes, if available. Do not pack the severed part in ice as this may damage the tissues. Do not immerse the severed part directly into water as the tissues will absorb the fluid and complicate the problem.

11. FRACTURES

A fracture is quite simply any break in the continuity of a bone.

All fractures require medical attention and your task is to ensure that the victim is given every possible assistance and that the trauma is minimised.

The general rules for the treatment of fractures are:

(i) The airways and haemorrhage must be attended to before considering fractures.

(ii) Fractures must be immobilised before attempting to move the victim unless there is an immediate threat from fire, explosion, toxic fumes, falling objects, etc.

(iii) Think carefully before attempting to immobilise a fracture and consider how you can make the victim as comfortable as possible and yet cause minimum disturbance to the fracture.

(a) When immobilising a fracture, any support or strapping should be firm but not so tight that circulation is impaired.

(b) Do not attempt to reduce the fracture or push back any bone ends.

(c) Use padding around any rigid supports, so as to prevent excessive pressure and discomfort.

(d) Periodically check for tightness of any strapping by feeling for a pulse or observing skin colour.

(e) Listen to the victim's complaints about numbness or tingling.

12. SMOKE INHALATION

Smoke consists of small particles of partially burnt material. The smoke created by a bush fire is normally made up of relatively harmless materials but the smoke incurred in property fires can be extremely dangerous. Many materials used in modern building practices give off toxic gases as they burn.

12.1 For bush fires:

(a) The main difficulties are -

(i) Distress caused by extreme irritation to eyes, throat and lungs.

(ii) Sore throat and chest muscles from excessive coughing.

(iii) Possibly, under extreme conditions, the throat and lungs may be burned.

(b) Assist affected persons back from the fireline and make sure they are resting comfortably. This should be sufficient for most persons to recover. If necessary, have someone stay with the affected person to monitor their condition. Any difficulty with breathing or any change in the voice must be treated seriously as it could indicate internal swelling as a result of burns to the throat or lungs. If this happens seek medical assistance immediately.

12.2 For property fires:

(a) The main difficulties are -

(i) The threat of suffocation. Remember that the fire is in a contained space and that it can quickly use up most of the oxygen in that space.

(ii) The threat of poisoning from noxious gases, as explained earlier.

(iii) The possibility, as with bush fires, of burns to the throat and lungs.

(b) Fire fighters who collapse from smoke inhalation whilst fighting property fires must be given medical attention as a matter of urgency. It may be necessary to apply E.A.R. (Expired Air Resuscitation) if the victim is not breathing.

13. BURNS

13.1 Burns severity

Irrespective of the severity of burns, the first aid treatments are the same.

13.2 Steps to be taken

(1) After removing the victim from danger, or the danger from the victim, there is still

considerable heat left in the skin. Cool the burn area with plenty of cool water. Apply the water until the burn is cool. Stop if the casualty starts to shiver, or, after 10-15 minutes.

Further treatment by immersion is ineffective and may actually lead to complications, such as, causing a chill that may induce shock, i.e. Hypothermia.

In addition to providing pain relief, cool water can stop the spread of the heat damage to surrounding tissues. Make sure that the victim does not get immersed in ice water - the rapid temperature extreme can cause severe complications. Direct application of ice to the burn can cause frostbite and complicate the severity of the burn.

(2) Look for upper airway obstruction. Especially if the face is burnt look for carbon material in and around the mouth and nose. Look for singed nasal hair. Look for redness or swelling in the mouth. A hoarse voice or noisy breathing when the casualty inhales are key signs.

(3) Cover the burnt area with clean material. Leave the covering loose, applying constricting bandages will further damage the burned area and may even tear burned skin from the body.

(4) If a limb is burnt remove all rings, tight clothing, shoes etc., and elevate the part (if possible) before swelling occurs.

13.3 Some Don'ts

(1) Do not break blisters or remove skin tissue.

(2) Do not use an antiseptic preparation, ointment, spray or home remedies on burns.

(3) Do not remove adhered particles or charred clothing from burnt area.

14. HEAT STRESS

14.1 The human body has an excellent cooling system. It needs it. The heat produced by the muscles and internal organs is 70 watts - the same as an electric light bulb - at rest, but can rapidly rise to more than 1 000 watts in strenuous exertion. This heat is carried to the skin by the bloodstream. During fire fighting, hundreds of watts more are gained from the fire and hot winds. To rid ourselves of these great

heat loads we rely entirely on sweating, which is a superbly efficient mechanism for cooling the skin by evaporating water from it. The amount evaporated can be as much as 10 litres (2½ gallons) in 8 hours.

14.2 To maintain the correct body temperature three things are essential:

1. The circulation must be able to carry to the skin all the heat produced in the body.

2. The skin must be able to produce the necessary amount of sweat, and

3. The sweat must be able to evaporate.

14.3 The failure of any link in this chain of heat transfer will cause body temperature and heart rate to rise. But the successful operation of the system will also lead to its eventual failure, unless the progressive dehydration caused by sweating is corrected by drinking sufficient water.

There are some common reasons why each link in the chain may fail:

1. The circulation is overloaded by trying to handle a heat load that is beyond its capacity - a capacity which may already be limited by poor physical condition or heart disease, and which will be progressively reduced if dehydration occurs.

2. Too little sweat is produced - a common cause of dehydration, lack of acclimatisation, old age, and certain medical conditions.

3. The sweat cannot evaporate freely enough to do its job of cooling properly because of too much clothing, too little air movement, or high humidity.

The most common adverse responses to heat are to feel weak, dizzy or sick. These effects are the result of overloading the circulation. As might be expected, they rapidly disappear when their causes are removed by discarding surplus clothing, resting in a cool, shady and well ventilated place and taking frequent drinks of water or fruit juice.

14.4 There are, however, two dangerous conditions which can occur if people ignore the early warning signs.

Heat Exhaustion

A person suffering heat exhaustion will become weak, dizzy or sick. These are the warning signs and, if ignored, the person may then develop the following symptoms:

Weak pulse
Shallow breathing
Clammy skin
Pale face

Heat Stroke

A person developing heat stroke will become irritable, confused or apathetic. These, once again, are warning signs, and if ignored, the person may then develop the following symptoms:

Rapid and strong pulse
Hot dry skin
High temperature
Flushed face

14.5 To assist persons suffering from heat stress:

(1) As noted earlier, move them to a cooler place, remove as much clothing as possible and create an air movement over the skin. Give small but

frequent liquid such as water or fruit juice. Do not give alcohol.

(2) Any person showing the symptoms of heat exhaustion will normally repond to this treatment although it would be just as well to seek medical assistance.

Any person showing the symptoms of heat stroke must be cooled immediately and moved to hospital as a matter of urgency. Every minute's delay in cooling the victim increases the likelihood of death or permanent injury.

15. SNAKE AND SPIDER BITE

There are only two spiders in W.A. which are capable of causing severe illness, and occasionally, death - the Red Back Spider and the Funnel Web Spider. There are, however, a number of venomous snakes and you should consider a spider or snake bite as serious.

15.1 Try to identify the spider or snake which bit the victim so that medical authorities can give the correct antivenene.

15.2 The first aid for all bite victims is the same except for Red Back Spider bite which is locally painful but

If venom has been injected it will move into the blood stream very quickly when the bandages are removed. The doctor should leave it in position until he or she has assembled appropriate antivenom and drugs which may have to be used when the dressings and splint are removed.

Bites on hand or forearm.

(1) Bind to elbow with bandages.

(2) Use splint to elbow.

(3) Use sling.

Note: Closely monitor any bite victim as breathing or circulation may fail and you will be required to commence CPR.

15.3

(1) Do not use a tourniquet for any bite.

(2) Do not remove the pressure bandage; this must be done by a competent medical person.

(3) Do not wash venom off the skin as this will assist in later identification.

16. LAST, BUT NOT LEAST, RE-ASSURE THE VICTIM

Remember than an injured person will be suffering pain and, most probably shock. There is an instinctive reaction for the victim to become anxious and frightened. Your behaviour can do much to relieve the victim's tension and so greatly improve the situation. Relieving tension and anxiety directly improves the victim's blood pressure, relieves shock, and therefore aids in recovery.

A few sensible rules:

(1) Be quiet and unhurried in considering the victim's injuries.

(2) Give assistance without fuss or flurry.

(3) Speak calmly to the victim and give realistic assurance. Tell the truth as far as possible for a casualty may be able to detect an obvious glossing-over of the situation and so become even more tense.

Re-assurance consists not only of what we say, but also how we say it; our sincerity and manner of delivery; our general calm approach, all combine together to set the victim's fears at rest.

17. ACTIVITIES

(1) The most important activity is to practise CPR. Brigades should contact the St John's Ambulance Association, the Red Cross, or the Health Department and arrange for a qualified person to give instruction in this vital technique and to supervise practice sessions.

(2) Practise placing persons in the recovery position.

(3) Practise immobilising limbs

(4) Practise bandaging for spider or snake bite.