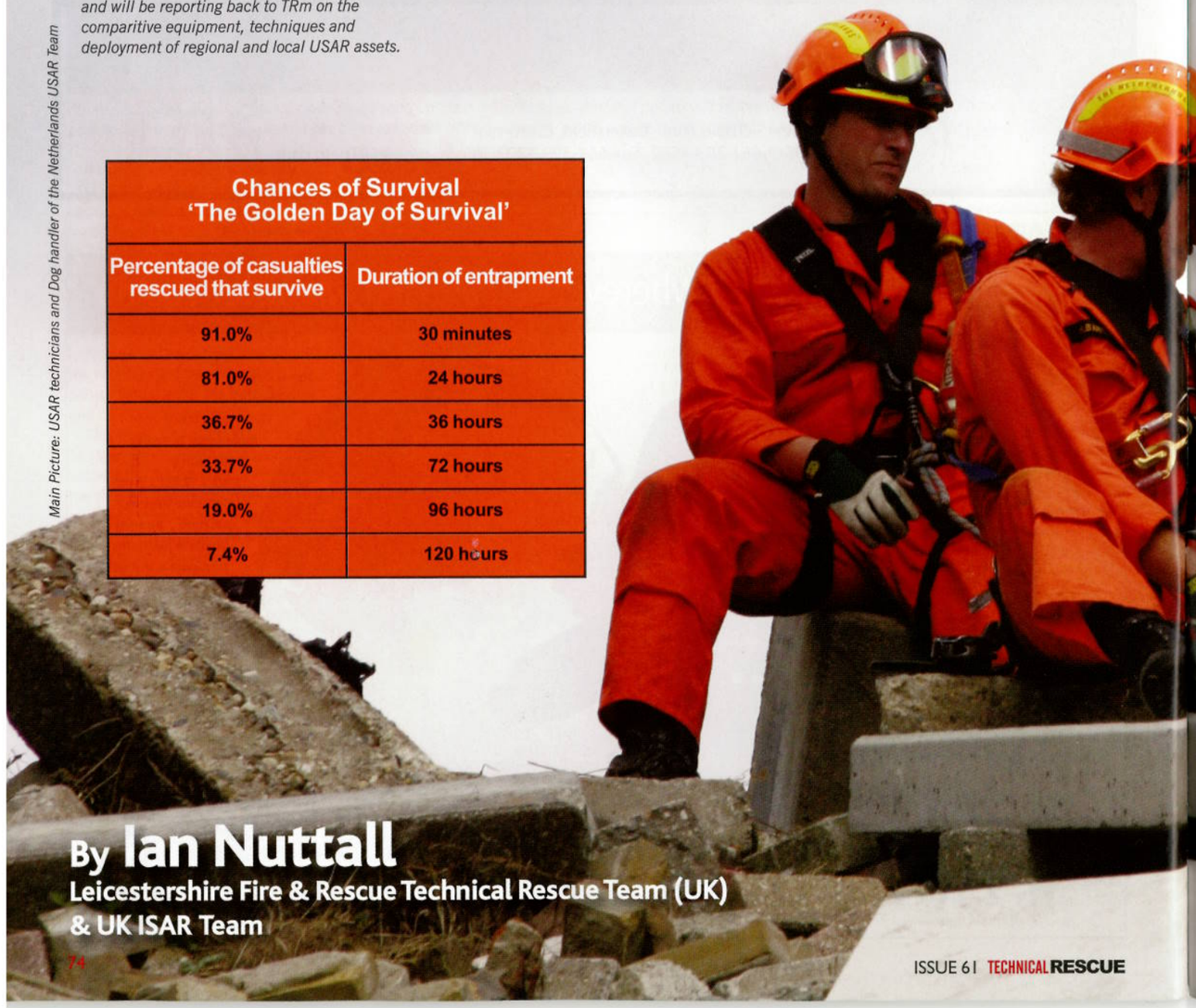
USAR BASICS

ED: Many of Technical Rescue magazine's articles are aimed at experienced and trained personnel looking to pick up tips and ideas from experienced authors. But we also like to maintain entry level content and this article by disaster veteran Ian Nuttall is actually from an original USAR Dog paper aimed at the UK Fire Service and operational partners. The majority of this article deals in detail with USAR dogs and how they operate but we begin with the fundamentals of Building Collapse Rescue which is relevant to virtually every rescuer and rescue agency regardless of whether you operate in an urban environment. The Thredbo incident in the mountains of NSW Australia a few years ago and the spring 2011 tornados in the southern US states claiming the lives of over 400 people showed that even rural and wilderness areas can require building collapse rescues.

Ian is shortly undertaking a Winston Churchill Memorial Trust Travelling Fellowship to the USA and will be reporting back to TRm on the comparitive equipment, techniques and deployment of regional and local USAR assets.

Chances of Survival 'The Golden Day of Survival'	
Percentage of casualties rescued that survive	Duration of entrapment
91.0%	30 minutes
81.0%	24 hours
36.7%	36 hours
33.7%	72 hours
19.0%	96 hours
7.4%	120 hours



Main Picture: USAR technicians and Dog handler of the Netherlands USAR Team

By **Ian Nuttall**
Leicestershire Fire & Rescue Technical Rescue Team (UK)
& UK ISAR Team

Urban Search and Rescue (USAR) is "a specialised technical rescue capability for the location and rescue of entrapped people following a structural collapse" (Mark Wilson-North, Personal Correspondence, 2007).

Within the U.K., USAR capability is concentrated mainly within the Fire and Rescue Services due to the Fire and Rescue Services (Emergency (England) Order 2007); however, certain Non Governmental Organisations (NGO's) are also involved, such as RAPID UK. The Emergencies Order provides a structured network of response from Fire and Rescue Services for the rescue of casualties in the event of any emergency involving the collapse of a building or other structure. The causes of collapse can be categorised as deliberate and accidental, including both natural and socio-technical (see table above):

"A structural collapse incident could comprise an unstable or collapsed structure(s) in an unsafe position" (http://www.usar.org.uk/buildingcollapse.htm, 2006).

Experience from previous incidents, for example the Oklahoma bombing in 1995 has shown that most collapses are not total and often leave numerous voids within the resulting debris in which casualties may be trapped, they may also have part of the structure still intact. Notable exceptions to this are the Twin Towers collapse which was so massive in mass and so high that most floors were simply pulverised and the Japanese tsunami which was so powerful and carried so much debris that those voids that might have remained viable in a normal flood were choked and pummelled by debris and the hydraulic action of the moving water. The effect of structural collapse can be numerous casualties trapped beneath, or entombed by heavy and often unstable debris.

It is unlikely that any structural collapse will involve all of characteristics shown in table above

TYPE		EXAMPLES
DELIBERATE	TERRORIST	Oklahoma 1995 Twin Towers 2001
ACCIDENTAL	SOCIO-TECHNICAL	747 crash into Towerblock - Schipol 19
	NATURAL	Hurricane Katrina 2005 Japan Tsunami 2011 S.USA Tornados2011

exclusively so the over-riding factor at these incidents is the location and rescue of trapped casualties. The trapped casualties' chances of survival depend upon rapid location and extrication.

Civilians and first responding crews conduct 80% of rescues at USAR incidents

The remaining 20% are either void space entrapped (15%) or totally entombed (5%) (Fire Service College, USRT1 Course Notes, 2005). Because of the dangerous nature of the incident, these casualties require rescuing by specialist USAR Teams as soon as practicably possible, due to the casualty survival rate decreasing with time trapped.

For any USAR incident to be successfully and efficiently resolved a coordinated approach is required. This is known as the Six Stages of Rescue.

The Six Stages of Rescue

Stage 1: Reconnaissance and Survey
- Area searched for possible victims and potential survivor locations
- Information gathered regarding missing person last known locations, structural assessment, extent and types of collapse

Stage 2: Elimination of Utilities
- All utilities evaluated and controlled for safety

Stage 3: Primary Surface Search and Rescue
- Site cleared of visible casualties

Stage 4: Exploration of Voids and Spaces
- All voids and accessible spaces to be searched
- Technical Search equipment used, including specialist USAR Canine Teams, Search Cameras and Seismic/Acoustic Listening Devices to locate victims

Stage 5: Access by Selected Debris Removal
- Selected removal of debris after the victim has been located. This may require specialist tools and techniques

Stage 6: Terminate by General Debris Removal
- Conducted after all known victims have been removed from the incident site. (Fire Service College, USRT1 Course Notes, 2005).

CATASTROPHIC	• Building > 10 storeys • Steel frame or reinforced concrete • More than 100 persons trapped • Over 10,000m2 of debris • Chemical, Biological, Radiological or Nuclear (CBRN) contamination
MAJOR	• Building between 5 and 10 storeys • Concrete or modular construction • Between 10 and 100 persons trapped • 1,000m2 to 10,000m2 debris area • HAZMAT contamination
MINOR / SIGNIFICANT	• Up to 4 storeys involved • Traditional construction • Fewer than 10 persons trapped • Less than 1,000m2 debris • 'Normal' contamination only

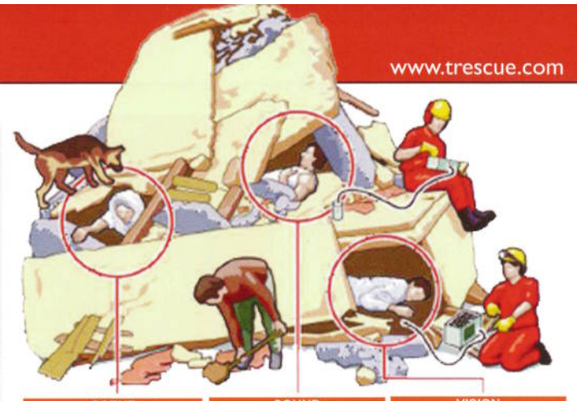


Figure 1 – Different components of Technical Search (image courtesy of Chris Pritchard, 2008)

USAR DOGS

Technical Search

During Stage 4, technical search operations commence with three main methods being utilised - audible, visual and **canine** - all with a common objective of casualty detection and location.

USAR Canines are trained to detect live casualties via air scenting as opposed to tracking and ground scent, this allows detection of casualties that are buried or inaccessible. "Scent can be defined as an odour that a live, dead or inanimate object emits" (Hammond, 2006), and an air scenting canine is orientated to detect airborne scent that is produced by a live casualty. Cadaver Canines are alternately trained to detect dead bodies or body parts, and these will not be discussed as they are not utilised within the early stages of a USAR incident. The primary purpose of the USAR Canine Team is to help locate those casualties that are relatively easy to rescue.

The secondary purpose is to identify further areas where casualties have become entrapped by debris sub-surface. This allows further technical search methods to be employed that are more time consuming to try to pin point casualties more precisely.

These methods may include audible detection using seismic and acoustic listening devices such as 'DELSAR' and visual methods including the use of a variety of search cameras. More accurate casualty locations are required because selected debris removal, Stage 5 of The Six Stages of Rescue, needs to occur within a relatively short time frame to maximize the survivability chance of the casualty however the canines can be utilised within Stages 1, 3, 4 and 5 of the Six Stages of Rescue.

Composition of USAR Canine Teams within the U.K. Fire Service

All Fire Service Search Dog Teams are registered as national USAR resources and are coordinated by the Fire and Rescue Service National Coordination Centre (FRSNCC) in West Yorkshire. At present there is a minimum of 20 canine teams positioned geographically throughout England and Wales.

A mobilisation request may be from a Fire and Rescue Service (FRS) with or without acanine team [following from communication with Chris Pritchard, 2008]

FRS with a dog team resource:

When tasking a dog team to a local incident, the FRSNCC must be informed. If further dog teams are required at the same incident, FRSNCC will coordinate the additional resources required. FRS without a dog team resource All requests for attendance of search dog teams will go through FRSNCC, who will mobilise and coordinate the nearest available dog team(s) to the incident.

A canine search team comprises:

- Fully trained and 'graded' canine and handler, which have the capability to work within a number of different environments and a safety officer dedicated to the canine team.
- The qualified canine 'Handler' is responsible for the dog and the canine element of the search. They know the capabilities, strengths and weaknesses of their dogs and must control the conduct of the search. Part of this is observing the dog's body language.
- The safety officer or 'Spotter' is responsible for the health and safety of the Handler whilst in the risk area at an incident. They are a trained competent search person with an awareness of how canine search teams work. The main role is to inform the canine team of hazards, look out for any escalation of hazards (i.e. further collapse), inform handler of possible search areas over looked and communicate with the incident command.

Canines work in areas where it can be especially hazardous for rescue crews to be operating, especially in the early stages. Due to them being lighter and having more points of contact (four) compared to a rescuer, they impose less of a load on an already unstable structure. As a result canine teams can be utilised very early on within the Six Stages of Rescue compared to other Technical Search operations. They are potentially safer as rescuers do not have to unnecessarily enter the risk area, the handler can direct the canine from a safe vantage point and a large area can be covered swiftly for any live casualties even if they are unconscious.

In order to understand the importance, role and operation of a USAR Canine the following factors need exploring to provide a greater knowledge about the potential of canines as part of technical search operations:

- What is scent?
- How it is scent detected?
- Factors that affect scent

What is Scent?

The true chemical nature of scent is unknown, however it can generally be interpreted as "all those combinations of odours or smells that characterize an individual" (Syrotuck, 2005), with "invisible particles that fly off of an object and are detected by the nerve cells in the olfactory membrane of the nose" (Chiacchia, 2007). However "there is no clear differentiation between scent, smell and odour" (Syrotuck, 2005).

Human Scent and the Human Body as a Scent Source

The human body gives off a constant stream of scent, very much like a smoke flare and in order to understand how a canine detects a casualty, the origin of human scent needs explaining. However there is a limited understanding of how the body creates scent and there are numerous factors influencing scent production. The major work regarding scent in relation to canines (Scent and the Scenting Dog, W. G. Syrotuck originally published 1972, however there have been numerous editions) concludes scent is "very complex and individualistic" and is comprised from the

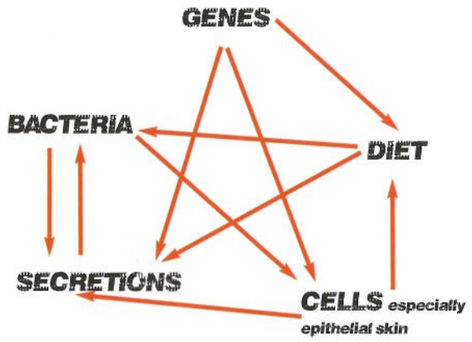


Figure 2 – The Human Body as a Scent Source (taken from Syrotuck,2005)

following:

- **Genes** – inherited factors that affect the body physiologically, for example the rate we produce hormones and racial differences such as the structure of the sweat glands (Syrotuck, 2005).
- **Diet** – the food we eat, how often and the rate in which it is metabolised is individually different within everyone, certain foods are expired through the lungs whilst others are secreted through both the lungs and skin, a prime example is that humans can detect garlic.
- **Cells** – the human body is created from approximately 60 trillion cells; these have a definite life span, for example, epithelial cells (the outer layer of skin cells) last approximately 36 hours and "it is estimated that 50 million cells die, in or on our body every second" and "dead cells (rafts) from the skin, respiratory tract, and digestive tract are constantly shed from the body" (Syrotuck, 2005). These rafts are approximately 14 microns in size (but can be up to 50 microns) (Orrock and Louis, 2003) and weigh approximately 0.07 micrograms (Curran, Rabin and Furton, 2005).
- **Epidermal Secretions** – skin glands contribute their secretion to the epidermis via sweat, oils and glandular secretions. There are two sources of sweat: Eccrine and Apocrine Sweat Glands. The Eccrine glands are located all over the body and the areas most abundant are forehead, palms, soles and axilla (armpits). According to Syrotuck (2005) the number of sweat glands per square centimetre are:

Sole of foot	600 Eccrine glands/cm^2
Forehead	360 Eccrine glands/cm^2

These Eccrine glands are capable of secreting between two and four litres of fluid per hour (Curran, Rabin and Furton, 2005).

The Apocrine glands are situated at the base of the hair follicle within certain regions of the body, axillae, areolae of the nipples, navel, perianal and genital region. These glands are specialised as the secretions are enhanced in response to stresses such as fear (Syrotuck, 2005). It has been shown that Apocrine secretions are essentially odourless, however

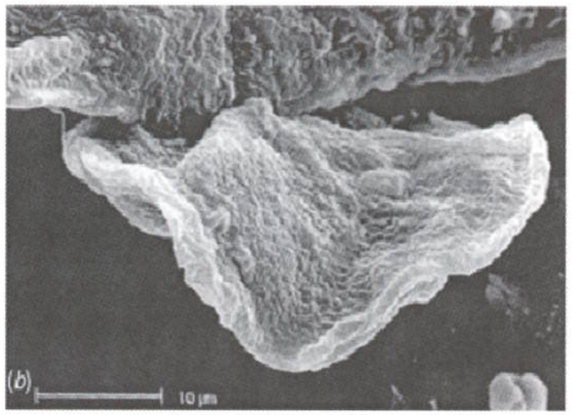


Figure 3 - Skin-rafts – are composed of one or more dead cells carrying approximately four microbial bacteria and is catalysed by body secretions. Skin flakes are 10-50 microns in diameter cornflake-shaped and aerodynamic (Orrock and Louis, 2003).

these glands produce proteins and oily substances that the resident bacteria feed off to produce characteristic odours.

- **Other body secretions** contribute substantially to the overall scent picture:

- Secretions from Sebaceous glands (associated with hair follicles) also mix with other skin secretions.
- Respiratory tract is constantly shedding cells.
- Genitourinary tract again is constantly shedding cells, and secretions have distinct odours of their own.

- **Bacteria** –These break down all components and secretions present on the rafts, this process of non-living tissue being broken down is called putrification, and the resulting products have characteristic odours (for example Methane, Hydrogen Sulphide and volatile (evaporate easily) fatty acids, (Federal Emergency Management Agency, 2004.) which will play an active role in human scent.
- **Miscellaneous** – toiletries, clothing and environmental factors including presence of petrol for instance. The idea that human scent is produced

AREA	BACTERIA PER CM2 OF EPIDERMIS
Axilla (Armpits)	2.41 million
Scalp	1.46 million
Forehead	200 000

Fig 4: Density count of bacteria in certain areas of the body (Syrotuck, 2005)

through bacterial action on dead skin cells and secretions is the most common depiction of the creation of human scent however, the role of pheromones is also considered a contributor to human scent.

Pheromones

Defined by Karllson and Luscher (1959) "are those substances released into the environment by an animal which are then subsequently 'received' by other animals" (Federal Emergency Management Agency, 2004), there are two types:

- **PRIMER pheromones** – these elicit a physiological response from an animal.
- **RELEASER pheromones** – elicit a behavioural response from an animal.

The characteristics of these are that they are simple compounds, of low molecular weight, volatile, lipid (will dissolve in fatty substances such as oil) and water-soluble (all meaning they can be easily dispersed and detected) and released via externally ducted glands: Eccrine, Sebaceous and Apocrine Glands (Federal Emergency Management Agency, 2004).

Therefore, the role of the epidermis and associated glands in the production of human scent is of major importance.

So, to summarise, the most popular theory is that bacterial action on skin rafts is the most important part of the human signature but others include: Pheromones, Work & Home environment (petrol, cooking smells etc),Toiletries, Clothing and Materials and finally Sweat (echine and apocrine).

The role of the Canine Olfactory System

Estimates on how much better a canine's sense of smell or OLFACTORY SYSTEM is, compared to ours, ranges from hundreds to hundreds of thousands. "The olfactory system is composed of the nasal chambers and sinuses which serve as receptor areas for scent" (Syrotuck, 2005) and the amount of brain dedicated to olfaction within canines has been suggested to range from 12.5% (Syrotuck, 2005) to 33% (Max, 2000) with over 50% of the internal nose area estimated to be dedicated to olfactory receptor cells.

It is estimated that an average person has 5 million olfactory receptor cells inside the nose, whilst a German Shepherd dog has 220 million (Syrotuck, 2005). This shows the potential superiority of the canine olfactory system.

• OLFACTORY LOBE – Part of the brain intimately connected with the olfactory
sense
• VOMERONASAL ORGAN – Narrow tubular canal starting near the front

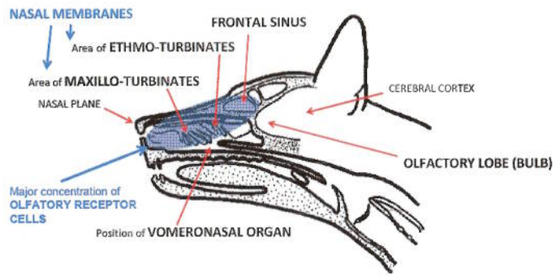


Figure 5 - Anatomy of the Canine Olfactory System

part of the nose, behind the canine tooth, it has olfactory cells and 608 nerve bundles that connect it directly to the Olfactory Lobe
• MAXILLOTURBINATE – Creates turbulence, heat and moistens air
• ETHMOTURBINATES – Fill the rear half of the chamber and contain the greatest concentration of olfactory receptors
• FRONTAL SINUS – Located in the bones of the forehead and contains olfactory cells
• OLFACTORY RECEPTOR CELLS – Are long, narrow cells with six to eight filaments at the upper end that protrude into the mucous layer. Almost every cell in the nasal olfactory epithelium has direct contact with a nerve which in turn is intimately linked with the olfactory lobe of the brain.

The Art of Sniffing

High-speed video has been studied to understand the mechanics of sniffing and how scent is brought into the large nasal cavity.

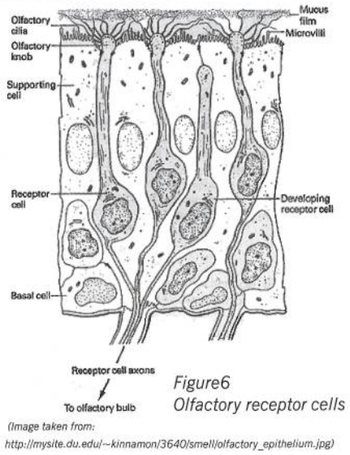


Figure6 Olfactory receptor cells

(Image taken from: http://mysite.du.edu/~kinnamon/3640/smell/olfactory_epithelium.jpg)

Airflow comes straight into the widened nostrils, adding turbulence to the olfactory cavity. Moisture on the nasal plane helps to capture scent as a dog's nose is normally cool and moist. The moisture secreted by mucous glands in the nasal cavity captures and dissolves molecules in the air and brings them into contact with the specialized olfactory/nasal epithelium (see pic below) inside the nose (as one of the characteristics of scent is that it is water-soluble) (Correa, 2005).

The scent-laded air is then transmitted onto the nasal membranes, which cover the nose's wafer turbinate bones. These bones have numerous convoluted folds, covered in mucous, ensuring that the tiniest

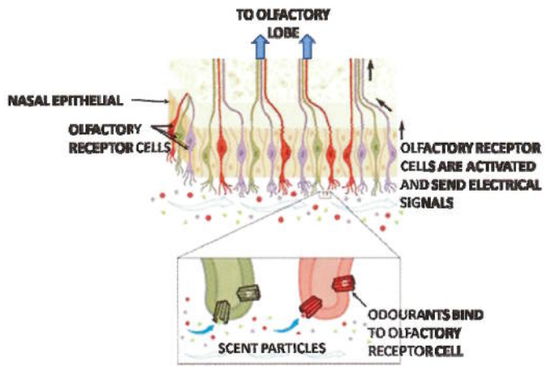


Figure 7 - Olfactory reception within the nose

amount of scent is captured. A bony sub-ethmoidal shelf, which is found below the ethmo-turbinate bones of the nasal cavity, forces inhaled air into the olfactory epithelium. Washing out of the region upon exhalation does not occur due to the nasal pocket created by the bony sub-ethmoidal shelf. The nasal pocket permits the odour molecules that are unrecognizable in a single sniff to accumulate and interact with olfactory receptors (Correa, 2005). The high density of olfactory receptor cells along the nasal membrane lining convert scent into chemical messages, which are then transmitted to the olfactory lobe.

Olfactory receptor cells in the vomeronasal organ also send impulses to the region of the hypothalamus associated with sexual and social behaviours. This organ is believed to be important in the detection of pheromones (Correa, 2005). Upon exhalation the nostrils flare and the slits on the side of the nose open ejecting airflow down the side. This means the canine is not exhaling onto, or disturbing the scent that is being 'sniffed', therefore allowing a weak scent to be detected (Max, 2000).

How Olfactory Receptors are Stimulated

How the olfactory receptors become stimulated by odourants is not clear. However, there are several identifiable characteristics of substances that elicit olfactory stimulation.
• Substance must be volatile
• Substance must be water-soluble so that it can diffuse through the mucous
membrane.
• Substance must be lipid soluble (i.e. dissolve in fatty substances) since the
membrane of the olfactory receptors and cilia contain a large amount of lipids.
(Federal Emergency Management Agency, 2004).

It is known that pheromones have the above attributes (see earlier), however skin-rafts are too large to dock directly with olfactory receptors, so the products that they carry are the necessary components for scent, and in one study more than 300 gaseous compounds were detected from human skin secretions (Chiacchia, 2007). It is suggested that different olfactory receptors respond to different types of olfactory stimulation, and there are two hypotheses that can explain this taken from Federal

Emergency Management Agency, 2004:
• CHEMICAL THEORY: olfactory receptors posses certain chemicals that react with
different odourants, the chemical composition of the odourant determines which
receptor it reacts with.
• LOCK AND KEY THEORY: the most widely accepted theory, this is where the
molecular shape of the odourant determines which receptor they may react with i.e. a docking protein on the surface of the cell is shaped to recognize the individual odour component, electrical signals are then sent to the olfactory lobe.

Transportation of Scent

Skin 'rafts' are shed at the rate of 40,000 per minute (Syrotuck, 2005) from a human body. Originally it was thought that these just fell to the ground, however studies have shown that there is a current of warm air that surrounds the human body (Curran, Rabin and Furton, 2005). Human skin typically at 33°C at normal activity levels, is significantly warmer that the surrounding air at room temperature. This causes a "steady thermal convection process, transferring heat from the body to the atmosphere" (Orrock and Louis, 2003).

This human thermal plume begins at the feet, travels up the legs and torso growing thicker and faster as it moves, it slows down under the arms and eddies under the chin before pluming from the persons head to a final dispersion height of 1.52ft above the head. The estimated speed of the thermal plume has been calculated to 1.42 MPH (Syrotuck, 2005 and Orrock and Louis, 2003).

The natural convection pattern that occurs is similar for everyone, despite differences in body height, weight and clothing (Orrock and Louis, 2003). Due to the size, nature and aerodynamic shape of 'rafts' these are easily transported via the human thermal plume into the surrounding environment and become airborne scent. Due to the scent particles being deposited by the thermal plume into the surrounding environment continuously the concentration of scent increases, and this is known as a 'Scent Pool'.

The scent pool is easily affected by wind, temperature and humidity, these factors can have a very complex effect on the transport of scent and how a canine detects scent and how the handler interprets this, especially within the open area.

The complexity of all these possible interactions will not be discussed in depth, but examples will be looked at to show how a canine team operates within the USAR environment. The best method of observing airborne

Figure 8 - A scent cone in open air, velocity of the air currents determines the shape and length of the scent cone. (Demonstrated with the assistance of Dave Coss, Ian Bunting and Tyke –Mountain Rescue Team Search and Rescue Dog - of Edale MRT. Image taken by author, 2007

scent is to study smoke generated at ground level. Figure 8 shows a scent cone, the scent that has been generated (possibly having been allowed to pool first) is moved via air currents resulting in different scent densities within this cone.

USAR canines are trained to indicate upon the strongest concentration of scent that it can detect. In an open area environment this might actually be the casualty, however within the USAR environment reaching the casualty may not be possible due to sub-surface entrapment.

Traditionally USAR Canines are trained for a 'Static Indication', where the canine traverses the scent cone to find the strongest concentration of scent. Once detected the canine remains in that position continuously barking until the handler arrives and rewards the canine. With open area search dogs (for example Search and Rescue Dog Association Mountain Rescue Dogs) these are trained for a 'Re-find Indication'. With this type of indication the canine detects the strongest concentration of scent and barks momentarily before returning to the handler barking again, and then returning to the point of initial indication, barking and repeating the process until the handler arrives at the location and rewards the canine. Some USAR Canines are now being trained to indicate like this due to the various types of incident that are encountered in a USAR environment.

Factors that Affect Scent

Temperature differences
- Heating can cause air to rise and therefore scent too
- Cooler air and materials can cause the air to sink

Pressure differences
- General atmospheric pressure is directly related to wind direction
- Can cause lifting and instability of air

Wind
- Moves scent and can cause large eddy currents
- Wind shadow behind certain object reduces wind speed and can pool scent

Topography
- Heating of different surfaces can cause thermal imbalances and thus generate air flow (can be caused by different thermal properties of materials or aspect of the site)
- Can trap air and create large pools of scent
- A collapsed structure can create Scent Channels where large/solid slabs or floors/walls/ceilings create a channel for scent to travel along directing it away from the casualty
- Or Scent Flows where broken rubble, broken reinforced/pre-cast concrete, collapsed walls and furniture create many channels in which scent can travel along. There are therefore numerous different variables

OPTIMUM WORKING CONDITIONS	DIFFICULT WORKING CONDITIONS
cool weather	hot weather
dawn & dusk	midday
light rain	snow or mud
light winds	strong or no wind

Figure 9 - Weather conditions and daily variations which effect scent and the canines ability to detect scent (Chris Pritchard, 2008)

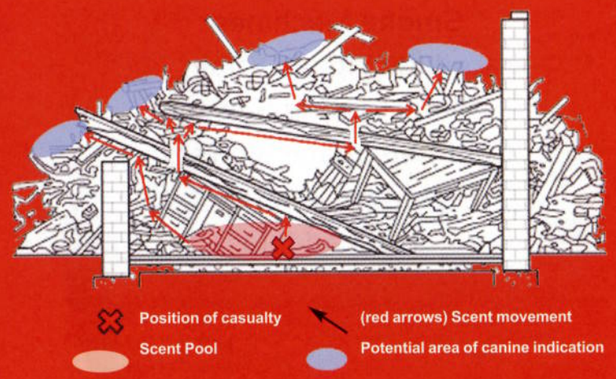


Figure 10 - Example of how scent can be dispersed within a collapsed structure (Original image from Civil Defence Handbook No. 7, 1960, additional information added via author)

Figure11 – With apologies for the qaulity this image is taken from a film recorded in Ohio, USA at a canine search course (courtesy of Teresa MacPherson, May 2007) a smoke grenade was used to represent scent emanating from a collapsed structure, note how smoke is present in numerous areas showing how scent channels transport scent/smoke away from the source

CONDUCIVE to SCENT DETECTION	NOT CONDUCIVE to SCENT DETECTION
broken concrete	unbroken concrete
wooden structures	rubberised/plastic materials
broken masonry & debris	sheet metal panels
water	

Figure 12 -Structural factors/elements which effect scent movement (Chris Pritchard, 2008)

that effect the movement of scent and the canines ability to detect the greatest concentration required to illicit a positive indication of potential casualty location.

Scent travels via the path of least resistance within a collapsed structure/ USAR environment and therefore the area where the strongest indication from the canine occurs may not be the actual location of the casualty.

For example, a smoke grenade was set off under a collapsed structure on a training exercise in the U.S. and as Figure 8 shows, the smoke (representing scent) is appearing through numerous scent flows and channels.

Types of Canine Search Patterns used at an USAR Incident

At the incident the handler will be briefed by the Incident Commander about the type of incident, potential casualty locations and hazards. In order to commence the search for casualties there needs to a search strategy decided upon. The search strategy will lead to one or more of the following search techniques being used. The following are all from discussion with the UK Fire Service USAR Canine Coordinator Chris Pritchard 2008:

- **Hasty Search** – A quick search of the area, generally used as the initial search. The speed of this search allows areas to be eliminated from the overall search area if there are no initial indications. Multiple areas can be covered very quickly, allowing the Incident Commander to direct resources

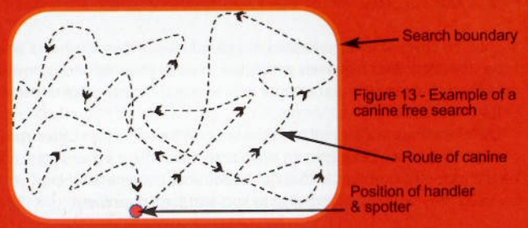


Figure 13 - Example of a canine free search

where appropriate. When larger search areas are defined or a more detailed search is required the search must be broken down into three main procedures:

- **Free search of area/room**
- **Systematic search of area/room**
- **Boundary/perimeter search of the area or building**
- **Free Search** – the canine is free to search the area on its own initiative with only verbal encouragement from the handler. This search relies on the handlers interpretation of how the canine is reacting to the environment,

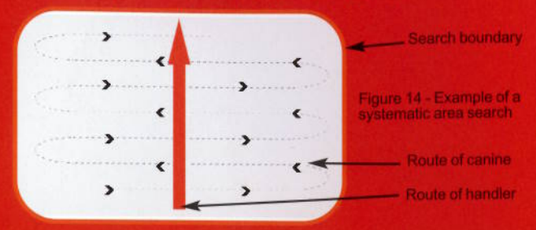


Figure 14 - Example of a systematic area search

any interest shown in areas and interpretation of wind and climatic factors. If the canine starts to look for assistance from the handler on the free search they should then take control of the search.

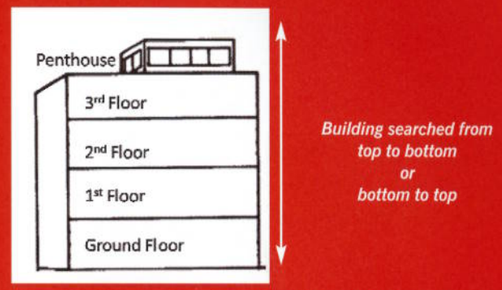


Figure 15 - How a building is sectored into systematic search areas

- **Systematic or Grid Search** – A controlled and methodical search using a defined pattern within a given search boundary, this ensures full coverage of the area. These can be broken down further:
- **Systematic Area Search** – handler directs the canine into specific areas

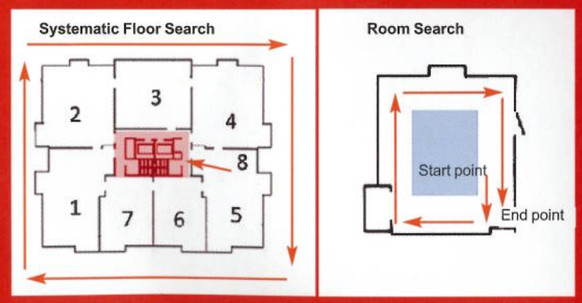


Figure 16 - Graphical representation of the systematic searching of floors and rooms within a building search.

or quarters the area. Quartering control is taught to a USAR Canine so it is able to search an area both quickly and efficiently and cover the area so as not to miss any part of the search area.

The handler can use hand signals and their body movement to direct the dog to the left and right of the handler's axis.

- **Systematic Building Search** – should be carried out after the free search. Floors and rooms are also searched systematically within a building.

A floor search involves the numbering of rooms in a methodical fashion and then systematically searching each room. The handler directs the canine around the room in a clockwise direction, over lapping at the start point before searching the middle of the room.

A full systematic search may not be required for each area, if the handler feels that the dog has sufficiently covered majority of the area with the free search. The handler may only then need to direct the dog to certain specific points of the area.

- **Boundary/perimeter Search** - is carried out as part of the search operation. On a building search, this includes any cellars, attics, garages and outbuildings that have been incorporated into the search area. Open areas also have their boundaries searched, with at least 5m covered in addition to the search area.
- **Fingertip Search** – periodically the canine team may need to re-cover part of an area in which the canine showed interest. With this scenario a 'fingertip search' can be used to concentration the dog's search in a small area, for example if the canine showed interest in a specific area but did not give a positive indication. The handler can re-search the area with the dog in a tightend systematic controlled search, guiding the dog by the use of the handler's hands and showing the dog the exact location to search.
- **Sweep Search** - As the layers of rubble are removed, it is good practice to re-commit the search dogs every few hours in order that they can sweep the whole site to locate any scent channels that may have been opened during the rubble removal. A minimum of two canine teams are required for any single collapsed structure/USAR incident in order to confirm the outcomes of the first teams search results.

Working Considerations

How a search is carried out depends on the size of the area to be searched. The basic search procedure will remain the same if the area is 50m2 or 10000 m2 but the area must be sectioned off into manageable search areas. During a search only one canine team at a time will be used so as not to distract the canine, however if there is more than one search area then simultaneous working can occur with one canine team in each area. Canines can work alongside other working personnel, however in order to work most effectively, personnel within the search area should be withdrawn so the canine is not detecting scent pools from rescue workers potentially causing false indications. This may not be practically possible, but is the ideal for the canine team to work in.

Advantages and Limitations of USAR Canines

As previously discussed the point at which the dog indicates is not necessarily the point at which any casualty will be found (this area can also be referred to as a hit). A second canine team will be utilised in order to confirm the previous positive indications (or hits) before deploying further resources to undertake a potentially protracted rescue. If another canine team is not available then other technical search equipment will be required which can increase detection time and delay any rescue operation (Chris Pritchard, 2008).

Advantages

- By working on scent, they enable the handler to interpret complex and, at times, conflicting information.
- Can detect deeply buried casualties that may not be observed by visual /audio search techniques.
- Can locate unconscious victims who would not be located by acoustic search techniques.
- Locate multiple casualties.
- Quick and effective in covering immediate areas.
- Search large areas in a short time.
- Traverse or gain access to voids rescuers cannot access.
- Very mobile and can be moved quickly and effectively to multiple search sites.
- Work night or day.
- Work remotely from a handler in a high risk or hazardous area.

Limitations

• It must be remembered that a search dog is not infallible. It is a living, non-verbal animal, and as such its effectiveness depends on the handler's ability to interpret the information offered by the dog.
• Not trained to locate deceased individuals. However there is no exact time scale to when scent changes from live to dead.
• Performance can be lowered if excessive distractions are present.
• Performance may vary according to individual canine or handler capabilities.
• Possible olfactory desensitisation due to working environment and presence of chemicals.
• Require a minimum of 6 hours undisturbed rest in every 24 hour period
• Scent affected by extremes in weather i.e. temperature and air humidity, where the scent can be suppressed. This may result in the dog not giving a positive indication.
• Short working period (20-30 minutes) at a collapsed structure
• The information has to interpreted.
• The type of collapse may trap casualties in airtight voids where the scent does not escape.
• They can get tired, hot and stressed.
• They respond and react to human scent, and can react to scent emanating from other people i.e. rescuers. In order to work most effectively, personnel within the search area should be withdrawn so the canine is not detecting scent pools from rescue workers, potentially causing false indications.

Summary

At an Urban Search and Rescue Incident the main purpose of all activity is generally casualty orientated rescue. As shown the survivability of entrapped casualties decreases sharply after the initial 24 hour period and rapid location and extrication are vital.

Within the Six Stages of Rescue the Urban Search and Rescue Canine Teams provide an excellent search tool very early on to allow rescue personnel and equipment to be deployed to the appropriate areas. In this environment the canines are used to detect areas where casualties are and other search equipment is required to locate them. As a result valuable resources and time are not tied up at areas of the incident where they are not required.

The major advantages of the Canines is the speed at which they work, they can cover large areas that are hazardous to other rescue personnel and locate multiple and unconscious casualties that are trapped sub-surface that other technical search operations may not be able to search (for example the snake eye search camera). The canines can also be used for Negative Searching of areas i.e. to confirm that there are no casualties within a certain area allowing for appropriate deployment of resources from the incident commander.

At least two canines teams have to be used at an incident to eliminate discrepancies from one canine to another, they have other limitations as previously covered, but the USAR Canine is a fantastic tool within the Urban Search and Rescue response of the U.K. Fire Service when utilised with other technical search equipment.

Bibliography

American Rescue Dog Association, ed., 2002. Search and Rescue Dogs – Training the K-9 Hero. 2nd ed. Wiley Publishing, Inc.

Chiacchia, K. B., 2007. Science of Scent 2007. [PowerPoint presentation]. Allegheny Mountain Rescue Group/Appalachian Search and Rescue Conference.

Correa, J. E., 2005. The Dog's Sense of Smell. (ACES Publications) [internet]. Available from: http://www.aces.edu/urban/Julio.html [cited 17 March 2008].

Curran, A. M., Rabin. S. I. and Furton, K. G., 2005. Analysis of the Uniqueness and Persistence of Human Scent. Forensic Science Communications, [online]. 7 (2). Available from: http://www.fbi.gov/hq/lab/fsc/backissu/april2005/index.htm [cited 25 June 2007].

Federal Emergency Management Agency. 2004. Overview of the Canine Olfactory System. [Internet]. FEMA. Available from: http://www.disasterdog.org/articles/overview_of_canine_ofactory_system_oct2005.pdf [cited 7 March 2008].

Hammond, S, M., 2006. Training the Disaster Search Dog. Dogwise Publishing.

Lancashire Urban Search and Rescue Team, 2006. UK Urban Search and Rescue. [website]. Available from: http://www.usar.org.uk/index.htm [cited 7 March 2008].

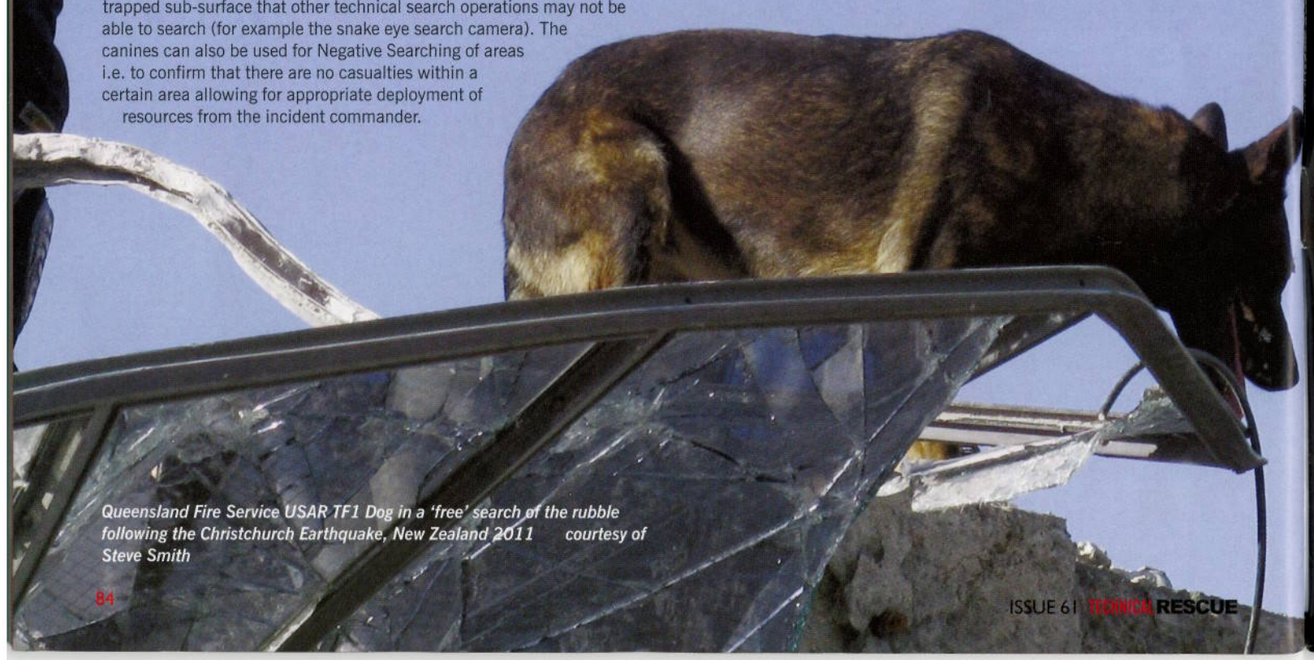
Home Office. 1960. Civil Defence Handbook No. 7, Rescue. Her Majesty's Stationary Office.

Max, J., 2000. Super Sniffer. (ScienCentral News article) [internet]. Available from: http://www.sciencentral.com [cited 25 June 2007].

Orrock, J. and Louis, C. 2003. NWS Intro: Airborne Scent. [PowerPoint presentation]. Wake Canine Search and Rescue.

Syrotuck, W.G., 2005. Scent and the Scenting Dog. 5th ed. Barkleigh Productions, Inc.

The Fire Service College. 2005. Urban Search and Rescue Technician 1 [USRT1 Course Notes]. Fire Service College.



Queensland Fire Service USAR TF1 Dog in a 'free' search of the rubble following the Christchurch Earthquake, New Zealand 2011 courtesy of Steve Smith