CONVECTIONAL TURBULENCE AND THE AIRSCENTING DOG

By Hatch Graham

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Handlers working Search and Rescue Dogs on airscent are very much aware of surface winds. They position their dogs so as to be downwind from all portions of their assigned sector during the search. Some days are obviously harder for the dogs. Why? One reason is that vertical air movement (turbulence) is as important as lateral movement (wind), and turbulent conditions may cause the dog and handler to miss the scent plumes.

Turbulence is caused either by deflection of the surface winds by mechanical barriers such as terrain features, vegetation, buildings, etc., or by convection caused by local climate.

This article will deal with convectional turbulence.

The Search and Rescue Dog literature often refers to the dog picking up a scent “cone” and following it to the victim. Perhaps the use of the term “cone” is appropriate for areas in the Pacific Northwest and elsewhere where cloud cover is prevalent and the scent plume most often disperses in a coning pattern.

Considerable research has been done on plume patterns in connection with air pollution studies. (Scent is dispersed in the same manner as smoke and other aerosols emanating from a continuous point source.) Often, the plume pattern is not cone-shaped.

Climatic or convectional turbulence is caused by atmospheric stability or instability, which is influenced by major air masses, solar radiation, and resulting air temperature gradients. Stability or instability can be determined by comparing surface temperature with temperature aloft. The greater the temperature difference, the more unstable the air and the greater the turbulence.

Often temperature gradient information can be obtained from a local airport, air quality control agency, or the National Weather Service. Even when information is not readily available, search personnel can often judge conditions by observing cloud formations, smokestacks, chimneys, or blowing dust. A smoke bomb can be a helpful tool.

Five common scent plume patterns result from stable, neutral, and unstable atmospheric conditions and their combinations. These are shown in Figure 1. The different scent plumes are indicated below.

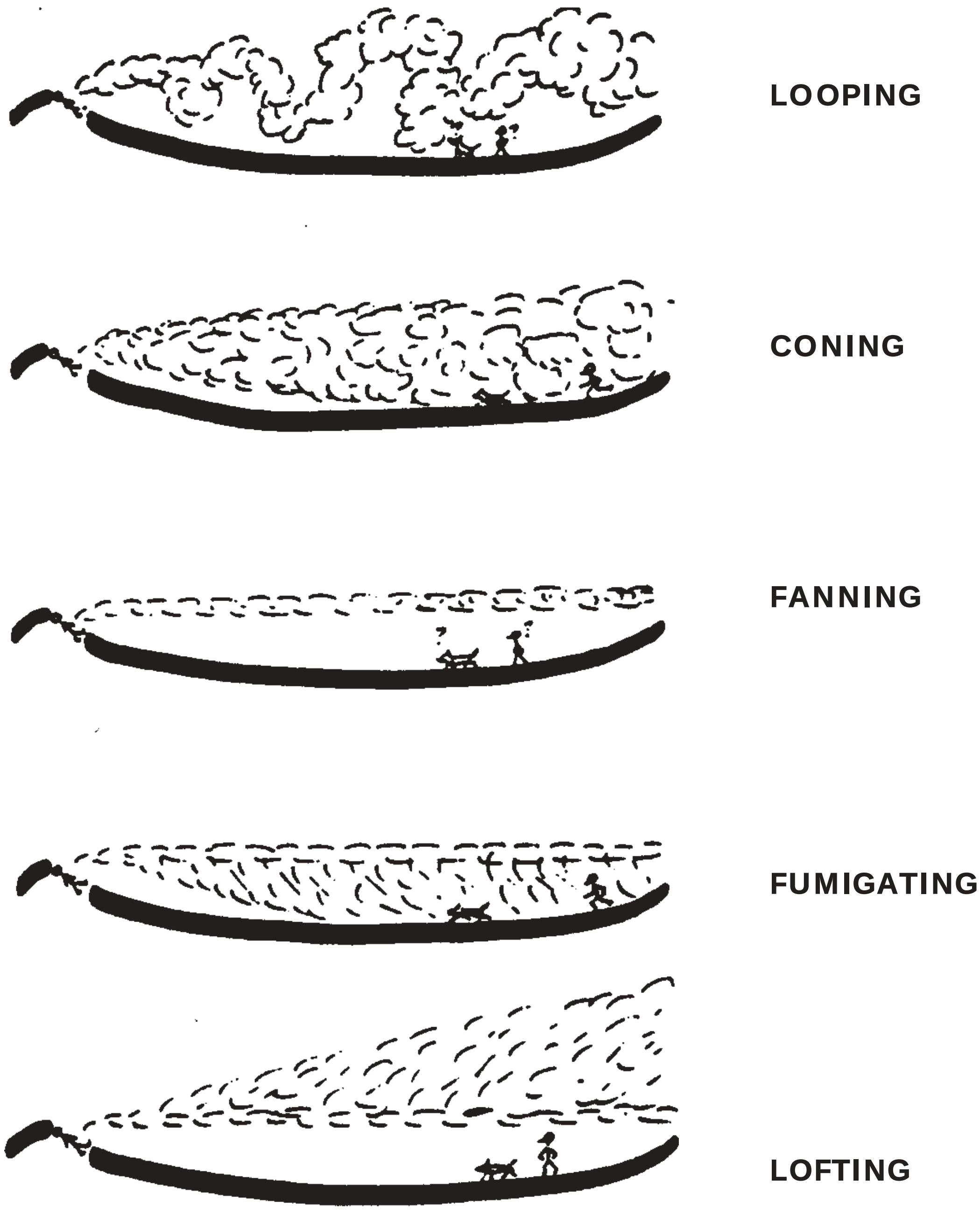

Figure 1 - Common plume patterns

Looping. This represents a high degree of convective turbulence. The air above cools at a higher rate than normal. (Normal is -5.5°F/1000' rise and is called dry-adiabatic lapse rate.) This superadiabatic lapse rate is usually caused by intense solar radiation on the surface. Air on the surface rises rapidly, cools quickly, loops back down, heats up and again rises, etc. The dispersion rate is rapid. When the loop reaches ground level, the dog will often alert by sniffing and looking skyward but won't be able to determine direction to the source. Noting such alerts on a map will often form a line of alerts pointing generally toward the source.

Coning. This represents neutral thermal conditions with a normal adiabatic lapse rate. It is typical on a cloud-covered day or night where effects of solar radiation and nighttime cooling are reduced. This creates excellent airscenting conditions.

Fanning. This occurs in the most stable air conditions when cooling aloft is reduced to about -3°F/1000'rise (the moist-adiabatic lapse rate). The scent plume is compressed vertically but fans out horizontally. If the point source is on the flat the scent will remain along the ground or the same elevation. If the point were on a hill, the scent could be overhead and out of reach of the airscenting dog at a lower elevation. This is essentially the result of an inversion layer and usually occurs just before sunrise on calm, clear nights.

Fumigating. This occurs with a combination of stable air aloft and unstable air at the surface. As the morning sun strikes the surface, it rapidly warms. The cooler scent plume will then diffuse down through the warmer air. High ground concentrations may occur for about one-half hour. This points out the advisability of having handler/dog teams in the field at daybreak.

Lofting. This is the reverse of fumigating. It results after the sun sets and the ground is cooling but the air is still warm. It is typical of valleys in the late afternoon and elsewhere in early evening; a stable layer develops below with a normal or superadiabatic lapse rate above. On calm evenings where this situation occurs, handlers should be working their dogs along ridges and higher slopes.

A typical sequence in clear weather is:

night - clear, calm	fanning
sunrise + 2 hour	fumigating
daytime	looping
sundown	lofting

In cloudy weather, the typical situation is coning.

This discussion deals with convectional turbulence only. It does not deal with the complex interrelationships of orographic (over mountain) lifting, eddying, upslope and downslope currents, differential convection between woods and fields, and many other types of mechanical turbulence which modify the effects described. Still, a knowledge of the fundamental types of scent plumes should help the handler to help his dog be in the right place at the right time and to work harder when the scent is looping or lofting.

SUMMARY CHART

Condition	Lapse Rate	Meteorological Description	Cloud Indicators	Other Possible Indicators	Plume Pattern
Stable	-3°F./1000'	Moist Adiabatic Lapse Rate/ Inversions	Stratus No vertical motion	Haze & Fog Steady breeze if any	Fanning
Neutral	-5.5°F./1000'	Dry Adiabatic Lapse Rate	Stratus often overcast	Relatively cool	Coning
Unstable	-6°F./1000'	Superadiabatic Lapse Rate	Altocumulus, Cumulo-nimbus, Thunderstorms or clear	Dustdevils, Gusty winds, generally hot or, in winter, clear & dry	Looping
Stable Aloft Unstable	-3°F./1000' -5.5°F./1000'	Inversion Lapse Rate	Same as Stable	Haze erratic breeze, if any	Fumigating
Unstable Aloft Stable surface	-5.5°F./1000 -3°F./1000'	Lapse Rate Inversion	Same as Unstable	Steady surface breeze, if any	Lofting

References: Stern, Arthur C., et al, *Fundamentals of Air Pollution*, Academic Press, NY, 1972
Hesketh, H., *Understanding and Controlling Air Pollution,* Ann Arbor Science, 1974

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