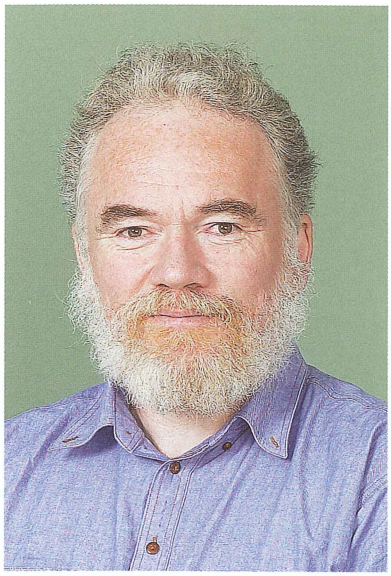


Learning, improving and blaming

Science and bushfires

Among the overall reactions to a major fire event of importance to fire services, are three which do not mesh well: learning about the event; improving community safety; and laying blame. These reflect the efforts of coroners, the media, researchers and scientists. They fall at differing places along a spectrum of rationality. The most rational reaction, science, takes by far the longest time.

In a paper presented to the 2011 AFAC & Bushfire CRC Conference, Rick McRae of the ACT Emergency Services Agency (ACTESA) discusses this from the perspective of the 2003 Canberra fires. This article represents the personal views of the author, not of ACTESA.

After a catastrophic fire event, there are three distinct modes of reaction in the Australian community, which includes the fire industry. These are, in no particular order: learning about what happened; improving how the community is protected from such events; and laying blame on someone for letting things happen.

Typically learning is done by researchers, who gather information about the event and apply standard tools to compare it to past events. Research often manifests in our industry as incrementally adding to what is already known. Note that this is a recipe for small changes, not radical changes.

Not often enough, scientific studies are carried out to see if our understanding of the event was fundamentally flawed and can be expanded. Science may be characterised as slow and impenetrable to most practitioners in the bushfire industry, but it does have the potential for forging major change.

The need to improve is often initially driven by the arrival of the duty coroner and attendant police officers, or governments announcing administrative reviews or royal commissions. Where there is room to do so without exposure to legal implications, industry-based reviews are also initiated. However, the greater the need for our industry to improve, the less control it has over the process.

The need for blame is often initiated by the popular media and driven by lawyers, who seek to sign up litigants, which may occur early or late in the scheme of things. The actions that ensue may be considered in the context of a rationality spectrum. Science sits at the high end of this spectrum. Research should also be at the high end, but is increasingly found elsewhere. Coronial inquiries are intended to be on the high side, but their performance in recent years has arguably shown otherwise. Litigation by definition, initially, falls at the low end of the spectrum. Reviews fall where the competing forces at the time allow them to fall.

We must question the wide spread along this spectrum of coronial inquiries. This reflects politics, the media, judicial perceptions and the influence of experts. These experts from the research area have a wider spread which also needs to be questioned. This manifests as a willingness to state: "I know what happened", before the science has been done.

To improve these modes of reaction, we must firstly scope out the science to be done, so that key areas are tagged as 'pending'. Opinions expressed within these areas must reflect the fact that science is yet to be concluded. We must also address the role of experts in the need to blame, which flows naturally from disagreement in opinion. If we truly knew how fires behave, we would never find experts on opposites sides in a courtroom. A strong industry role in maintaining a pool of independent experts may be needed.

In order to show why these issues need attention and how to tackle them, I would like to review some facts arising from the 2003 Bushfire Coronial Inquiry in the Australian Capital Territory.

The basis of the coroner's findings, built from testimony by experts, is a chain of logic presented in adversarial circumstances to the witnesses. "We knew the weather, as it had been forecast. We knew how to predict what a fire would do under those conditions because we knew the fuel loads and the terrain. With that prediction we can get close to the actual outcome. Therefore you should have done the same. Had you done so, the outcome could have been mitigated."

The foundations of this argument are knowledge of weather, terrain, fuel and fire behaviour. It also assumes precise and unambiguous interpretation of inputs to the calculations. In other words, on the specified conditions, anyone doing the calculations would reach the same results. It also assumes that the tools used are valid, unique and not open to question. Any practitioner in this arena will appreciate the fallacies embedded in these assumptions. Anyone versed in courtroom drama knows the pitfalls of ex post facto arguments. Using such arguments, the fog of uncertainty that pervades incident management teams in escalating situations can be conveniently ignored.

The science that has arisen from the 2003 ACT fires now covers 11 papers in refereed science journals, with

two published in 2010, three in 2009 and the others in 2006 and 2007. In these papers a number of concepts that are new for the Australian wildfire community have been posited and have proven to be of a suitable standard for publishing in a peer-reviewed science journal. These concepts include pyro-tornadogenssis, the dominance of lee-slope eddies, violent pyro-convection, dry slots, fire channelling and foehn winds.

Of these none were openly discussed in the coronial inquiry. Dry slots were aired in the media during the inquiry, and what is now termed pyro-tornadogenesis was referred to on the first page of proceedings only. Had they been discussed, the logical outcome of the inquiry may well have been that as violent pyro-convection had only been confirmed in Australia in the Big Desert Fire of 2002, there were no procedures in the industry to handle such events. Of course, the science had not been done then. If the inquiry had waited for the science, then the findings may have been more favourable for the long-term protection of the Australian community.

The next benchmark fire event was Black Saturday. This was watched with concern by pyro-convection researchers around the world. Like the Canberra fires, Black Saturday is leading to new understanding of the behaviour of particulates in the upper atmosphere, of value not just to firefighters but to climatologists and cosmologists. Would Black Saturday have benefited if there had been more focus on the science, and less on the legal arguments, that came from the 2003 fires? Many of the key concepts behind the development of extreme fires were discussed in the published literature and in conference proceedings at that time. This knowledge could have made it clear that suppression was futile and the combination of elevated fire danger and the vertical structure of the atmosphere would, through processes such as fire channelling, lead to plume-driven fires. Consequently, many operational strategies could have been different. In both fire events surface fire tools can be tweaked to give close to predicted final outcome, but they give no insight into how that outcome came about.

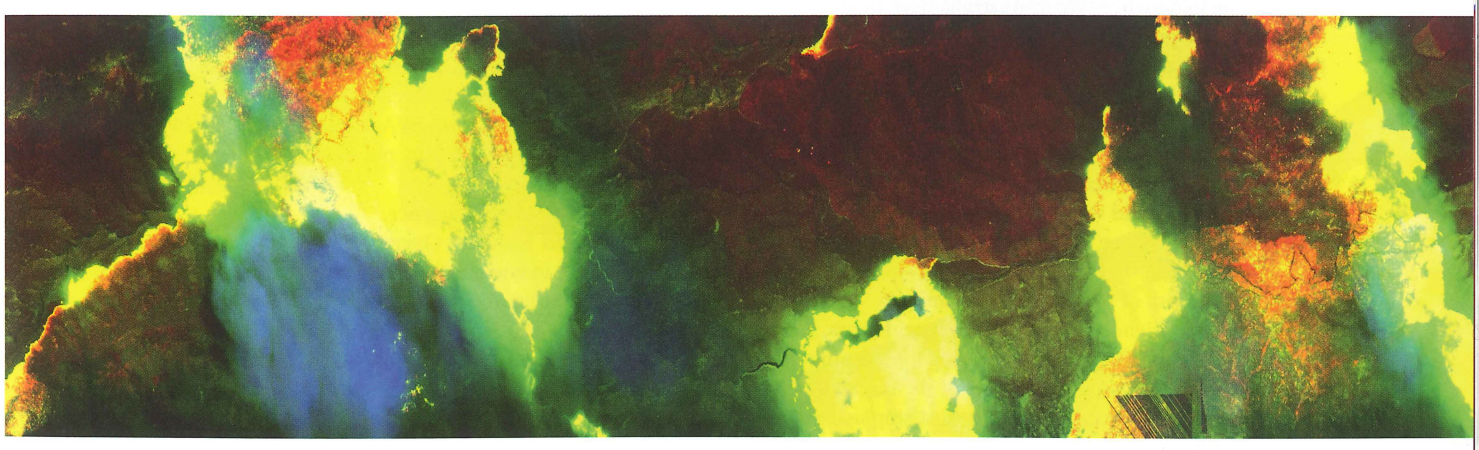
It is not simply a requirement for researchers to write their papers. The results need to be interpreted into meaningful learning outcomes for the thousands of fire officers who may be tasked with making the calls at the 'next big one'. Another problem that besets our industry is the one-size-fits-all mindset, the opposite of a willingness to canvass alternative ideas. To demonstrate: imagine a sudden wind-change causes a fire tanker to be burnt over. Why did this happen? The standard explanation is a poorly forecast wind change. This carries with it the claim, "if only the forecast had been better, we could have got them out of there!"

On the lee side of a ridge there can be a distinct wind flow called a lee-slope eddy. When the winds are low, these eddies may be absent, but when the winds are strong they are almost certain. So as the winds pick up in the afternoon, there may come a point where a small increase in winds causes a sudden, and critical, switch in wind regime. This results in a sudden wind change. It does not require a synoptic wind change. Equally if these eddies are in place there will be a point on the side of a ridge where we could be just outside of the eddy regime. A slight backing of the wind direction could move such a site into the eddy field, creating the sudden wind change. A slight wind shift is a natural result of thermal mixing and does not require a wind change. So, we can have three different processes that produce the same disastrous result on the ground.

The application of scientific understanding of these processes allows us to collect evidence that rules out one or more of these explanations and acts to support others. Thus we reach a valid conclusion as well as lessons that may be meaningful in the future. It is necessary to state that while it may take months for researchers to compare possibilities, the crew leader on the day may have minutes.

Science is about raising hypotheses so that they may be challenged and weeded out if they prove unsound. From the end-user's perspective, science is paired with the notion of evidence-based policy. This says that a policy should only be adopted if it has scientifically-validated evidence behind it. The vast majority of the policy used in wildfire management has not been scientifically validated. While it is tempting for many old hands to claim that they know what fires do, the cautionary tale of the unexpected wind change discussed earlier shows that what is usually called bad luck is actually a set of routine phenomena that need to be identified and expected to occur.

Perhaps an even more salient point is that our species has been playing with fire for perhaps millions of years. In all of that time, fire channelling has not been identified. The science arising from the 2003



Fire balls may have been recorded in multispectral linescans of fires, and consistent mechanisms for their formation have been identified.

fires has shown that fire channelling has been defying incident management teams in many countries and has killed many people. In fact it is the big-ticket lesson from the 2003 fires and nobody knew about it until 2004. It killed people on Black Saturday. Unless we listen to the science it will kill people in the next Australian extreme fire.

It is for the goal of learning real lessons from fire events that we must turn to science. We must recognise our fundamental ignorance on key matters of fire behaviour. How many have had a discussion about fire balls? How many concluded that they are an old wives tale? How many know that they have been studied and found plausible by researchers from Manchester, in collaboration with local scientists? How many know they may have been recorded in multispectral linescans of fires, and that consistent mechanisms for their formation have been identified? It really does come down to 'what we know that we know', 'what we know that we don't know' and 'what we don't know that we don't know'. Fires have taught us a lot and have a lot to teach us. None of our understanding of fires has come from a courtroom.

If the various species of inquiry are to be truly aimed at learning lessons and making the community safer in the face of the next event, then it is unthinkable that they would not seek to be in synchrony with the passage of science. It is equally unthinkable that they should not form a stronger link with science. Remember that science is about striving to be disproved. As many in the industry would know, giving evidence in court as an expert witness is about not being disproved. It is about vigorous defence of any claims made.

It is this difference that permits the court proceedings to be decoupled from the science. It has pushed us into an arena where the expert with greater gravitas can win the debate in court. There may be a yawning chasm between charisma and science. Over time, the repeated victory of appearance over substance can also lead to the creation of dogma – a set of facts that is accepted and no longer challenged. Dogma is also staunchly defended against the unbelievers. This is the most dangerous possibility in all of the matters that I have discussed: the unthinking resistance to new thinking, that arises so easily from a comfortable, shared mindset.

There is a limit to how far we can go in basing our practices on experience. We in Australia have made astonishing advances this way, but we are now hitting the wall, in the athletic parlance. We are going through extreme fires, possibly the harbingers of climate change. We are facing events for which we really have no experience base. We are finding that business components, like fire weather, are far more technical than most of us would wish them to be. We are increasingly having our business practices challenged in public inquiries.

We run the risk of squandering the unique opportunity for science offered to us in recent years, as governments pledge increased funding for learning lessons. We, collectively, are in charge of the research agenda and we need to do better. We must stop using that agenda to shore up our established ideas. We must be open to challenge.

I would like to provide some positive suggestions for the future.

Firstly, the science that has come from the 2003 fires owes much to the tasking on that day of the multispectral linescanner, then on contract to the New South Wales Rural Fire Service. This is a type of scientific device of immense value to Situation Units in IMTs and for post-analyses. Without high quality, multispectral, rectified datasets it is difficult to unravel the complexities of extreme fires. These must be augmented by photographs, videos, satellite images, weather time sequences and whatever else is out there on the day. We must be willing to acquire such capabilities and task them. The primary data of value to science may not be acquirable after the fact.

Secondly, we must be able to see the scientific hypotheses that are opened up by such datasets. We need staff widely-read on the range of ideas in the literature. They need to be able to list and compare alternatives. They need to be able to recognise the possibilities for testing ideas from high-quality field data. This requires a national collaboration that goes far beyond what is possible today. As another view of this point, we need to go from a state where eight staff members means eight opinions to a state where one staff member might have eight hypotheses.

Thirdly, we must staunchly defend the process of testing those ideas in the face of media demands, political imperatives and legal gravitas. We must, as it is the only way to provide protection for our communities in the future.

It is worth remembering what's been said before at conferences by Naomi Brown, Justice Kirby and Michael Eburn, and of stated positions on these matters:

"Our membership is deeply concerned that these inquiries are trending towards apportioning blame rather than finding outcomes that lead to an improvement in the way other emergencies are managed.

"All reviews and investigations into bushfire events at any level, internal or independent, need to focus on learning and not blame. The inquiry approach needs to focus on this outcome, in the interests of all involved. Coronial inquests into bushfire matters, other than deaths, may not be the most suitable form of inquiry."

So I'll finish with a challenge to all of you – the people responsible for managing wildfire in what may become known as the era when frequent, violent, pyro-convection became the norm in Australia. When you get ready for the next fire season, put onto your checklist the following:

1. Review the relevant bushfire science.
2. Check whether your Standard Operating Procedures for use in a major fire event incorporate the new learnings.
3. Make sure that you can deploy or access remote sensing data.
4. Ensure that that data is available to assist decision-making during major fires.

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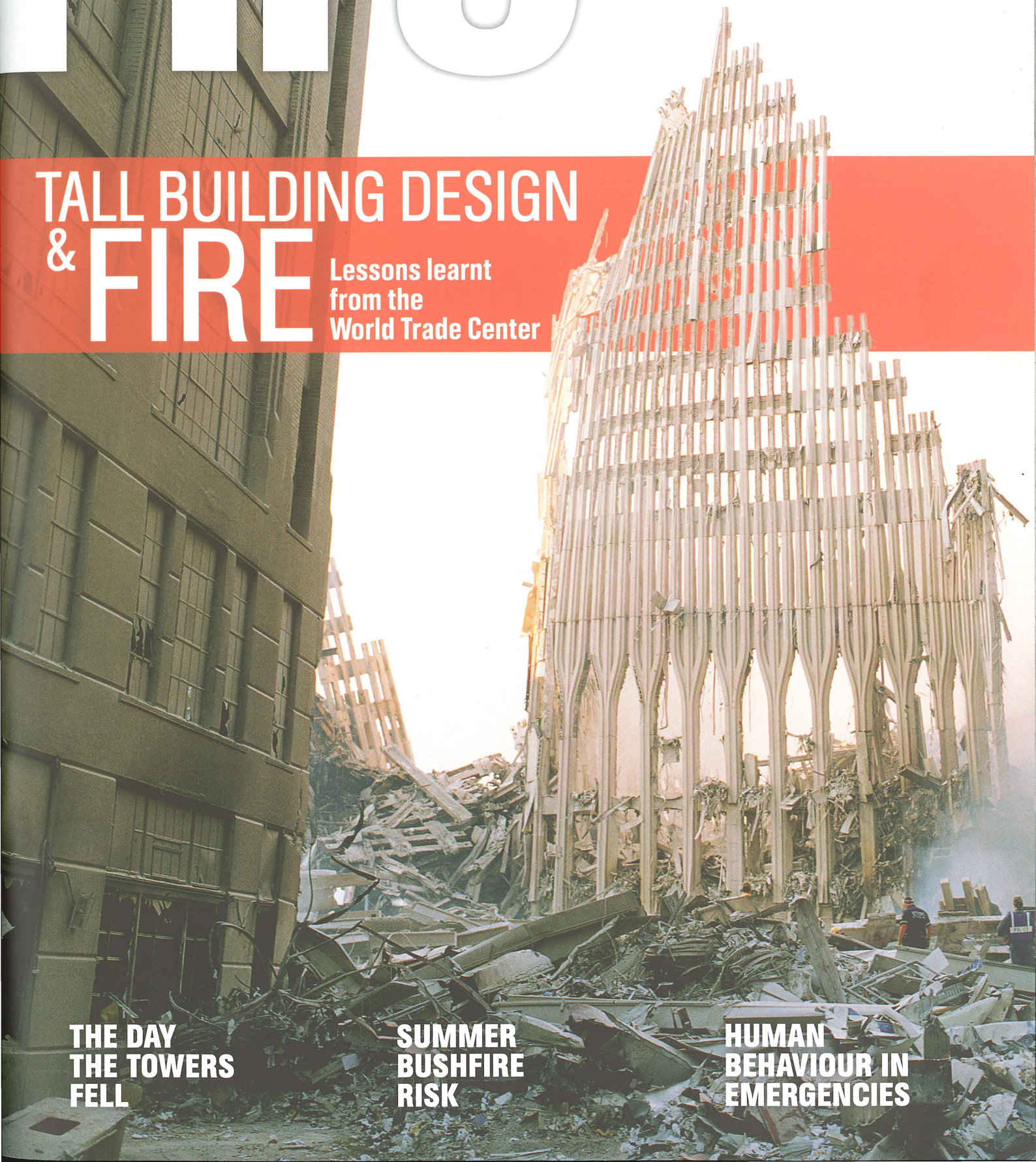
TALL BUILDING DESIGN & FIRE

Lessons learnt from the World Trade Center



THE DAY THE TOWERS FELL

SUMMER BUSHFIRE RISK

HUMAN BEHAVIOUR IN EMERGENCIES