

CONCLUSION:

This website is dedicated to the hundreds of thousands of Canadians who have fought and died for freedom from tyranny, freedom from the predations of criminals upon the weak. Both outside the borders of Canada and within. For the Armed Forces, the Police services and others, who fight to protect the average citizen. For those who believe every citizen has certain duties and obligations as a good citizen. To go to war against a genuine enemy of a just state. To go to war against an illegitimate government who believes the weak, the injured and the vulnerable in society are to be preyed upon. This is just my very small part, a duty so to speak.

I thank you for your help, your interest your support and your efforts to fight corruption.

I apologize that the documents are not in order of time or filing. As it was it took two weeks to scan these documents. I wrote the introduction and then added narrative as I went through the motions and filings. I stated at the start that I fired Mr. Armitage but clearly he quit when I sent him the letter instructing him to re-open the matter that he had just set down for trial and conduct Examinations For Discovery of the SGI Adjustors.

At trial the ambulance attendant stated that the accident occurred before there were logbooks. But that's not in fact what she told me when I first talked to her. Clearly statements or letters should have been obtained in a timely fashion. The same applies to Cst. Laurent. He had long since lost his notes and couldn't recall much of anything about the accident and subsequent investigations. That's why the criminal conduct in cleaning out the adjustor's notes and investigations meshed so well with 10 and ½ years of non-disclosure. After that much time there is nothing left to investigate.

The concept has come up again and again by lawyers that they "would represent me on the injury issues but not on the "Bad Faith." Don't be fooled by such thinking. What they are saying is that the law doesn't apply to us (lawyers); it only applies to everyone else. But at the same time if the original evidence is missing you are going to trial with both hands tied behind your back. Dietz is allowed another crack at what he does best. Lie. Lie to avoid responsibility for his actions. If you're found liable because there is no real evidence left. Well you still have to pay the legal bill. It's not bad faith. Its plain and simple fraud.

When a senior partner of the biggest law firms in Edmonton states that "no one at this firm is interested in work like that". He is saying as far as this law firm is concerned the law doesn't apply to us. Doesn't apply to our colleagues. Doesn't apply to our industry. A statement like this should send alarm bells ringing nation wide. But it doesn't.

When a lawyer makes statements like "perjury is protected by privilege". It's a plain lie designed to mislead. In fact the rules of the Law Society state that when a lawyer realizes that a client is lying he is required to withdraw form the case. That's why you have the current perversions of justice. What I'd call the Kabuki Theatres of Filth. Where lawyers

will state like in the newspaper article in this section “Hells Angels are Law Abiding” when in fact they are a criminal gang. All you have to do is follow the money.

Don’t be fooled by lawyers that don’t know you can conduct an examination for discovery of any party who has knowledge about a matter. It’s obstruction of justice and cover-up. Its participation in a fraud.

Don’t be fooled that ANY member of the bar needs to “examine” the matters to discover if “bad faith” is involved. This has fraud cover-up and filth plastered from one end to the other starting at the Statement of Defence at a year and a half after the Statement of Claim.

That’s why you get cases where the lawyer states that his client was just walking through the park at three a.m. when he came upon the nude dead body of a child and decided to have sex with the corpse. That’s how his DNA came about to be inside the corpse. Then of course the judge doesn’t believe the lawyer, twelve jurors don’t believe him and the courts of appeal don’t believe him. But the lying game goes on. The rackets of law.

There exists a hegemony of filth of the legal industry and its impossible for the judiciary to be unaware of this. Canadian Lawyer magazine has lawyers and politicians at 30-35% honesty and 60 % outright corrupt as far as the public is concerned, but for the judiciary its 100% honest. Clearly there is a broken system.

The lawyers are Rats story states it completely right “LAWYERS ONLY REGULATE THEMSELVES PURSUANT TO LEGISLATION THAT IS PASSED BY PROVINCAL LEGISLATURES, WHICH THEY COULD CHANGE TOMORROW.”

The story further states, “As professor Tanovich notes, one of the problems in assessing and policing unethical conduct among Canadian lawyers is “the wall of silence that forms part of the elite firm culture.” Our interviews broke through the wall. And, yes our headline was tough, but one of the bright consistent threads thought the literature on the problems of the Canadian legal profession is that legal professionals are more interested in maintaining a lucrative status quo than in confronting the need to reform.”

REALLY... OBVIOUSLY THE MESSAGE HAS NOT BEEN RECEIVED BY THE POLITICAL THAT NEEDS TO REGULATE THIS INDUSTRY AND HOLD IT TO ACCOUNT.

Sask. drivers will cash in on SGI surplus

Saskatchewan News Network

REGINA — Cheques to Saskatchewan residents are on the way compliments of the province.

No, it's not as much as the \$400 that Albertans received last month from their government.

Rather, rebate cheques for vehicle owners will be in the mail by the end of May as SGI's auto fund returns a portion of its \$60-million surplus from last year, Glenn Hagel, minister in charge of the Crown corporation, said Thursday.

A one-time, eight per cent rebate is being calculated on owners' 2005 vehicle insurance premiums. The average cheque will be \$87. All vehicles, both private and commercial, are eligible for the rebate, including snowmobiles and trailers.

The eight per cent will be applied before safe driver or business recognition discounts are calculated, said Hagel. About 520,000 customers will receive the rebates.

The auto fund will also remain at current rates for the sixth year in a row, said Hagel.

The rebate is possible in part because there have been fewer collisions, he said.

"Most Saskatchewan motorists are safe drivers and safe drivers mean fewer collisions," he said. "Fewer collisions combined with increased investment earnings and sound fiscal management have all contributed (to) the 2005 auto fund experience."

But a rise in stock market investment returns for SGI is the biggest reason why the Crown can hand out rebates, said Dan D'Autremont, a Saskatchewan Party MLA. The fact the government is giving out cheques rather than cutting 2006 rates points to the stock market as being responsible, he said.

"It's a political exercise as much as a means of returning the money to the vehicle owners," he said. "Do they expect drivers in Saskatchewan are going to be eight per cent worse next year? If they're doing such a good job of managing, if their safety programs are doing such a good job, shouldn't this be an ongoing reduction?"



Hagel

Fund in one-time position

A cut in rates may lead customers to grow accustomed to a lower rate that may not continue beyond this year, said Hagel.

"This has been a special year and that has enabled us to be in this one-time position. We can't predict with absolute certainty that this will continue," said Hagel. "We need to be able to keep protecting our ability to keep the lowest rates in the nation and our objective of continuing the rates without increasing."

The rebates will eat up \$45 million of the auto fund's \$60-million surplus for 2005. The other \$15 million will go to a "cushion" for SGI should 2006 or future years see a downturn, said Hagel.

SGI's wasn't expecting a surplus in its auto fund for 2005 when it applied to the rate review panel for a 10 per cent rate increase in July 2004. A \$26.6-million loss was predicted for 2005 at that time because of the increasing cost of damage and personal injury claims. SGI withdrew the rate increase request in October 2004, citing a better financial picture.

Having most customers covered by no-fault as opposed to tort coverage contributes to more stable rates, said Jon Schubert, president of SGI. Claims for injuries have remained fairly stable. Payouts for injuries have increased with inflation and also because of a \$21-million increase to injury benefits for those injured before no-fault.

The rate of collisions has continually declined since 2003, Schubert added.

(REGINA LEADER-POST)

BUSINESS

The StarPhoenix Friday, April 21, 2006

Business Editor Murray Lyons Phone 657-6239

SGI rates continue as lowest in Canada

Saskatchewan News Network

REGINA — A reduced number of accident claims and robust investment income resulted in a hefty surplus in the Saskatchewan Auto Fund in 2005 and the sixth straight year of stable rates, says the minister responsible for SGI.

"SGI customers will continue to enjoy the lowest (auto) insurance rates in Canada, with 2006 marking the sixth year in a row with no general rate increases," Glenn Hagel told a news conference Thursday.

In 2006, the fund will return \$45 million to 520,000 vehicle owners through an eight per cent rebate on insurance premiums paid in 2005, plus an additional \$75 million back on premiums through discounts, Hagel said.

Jon Schubert, president and CEO of

SGI, which administers the Auto Fund, said the rebates and discounts were made possible by the large surplus.

The surplus was caused by favourable claims results and continued strong investment earnings, which increased to \$68 million in 2005 from \$63 million in 2004.

The province's compulsory automobile insurance program reported a surplus of \$61 million in 2005, which increased the balance in the fund's rate stabilization reserve to \$163 million.

The surplus was partly the result of the declining accident rate, which has reduced damage claims to 107 per 1,000 vehicles in 2005 from 114 per 1,000 in 2003, saving the fund \$30 million in claims costs last year.

(REGINA LEADER-POST)

Winnipeg police officer faces attempted murder charge

Last Updated: Friday, April 3, 2009 | 7:11 AM CT Comments97Recommend58
CBC News

A Winnipeg police officer will be charged with attempted murder, and another officer will be charged with lesser offences, after a man was shot during a robbery investigation in 2007.

The police officers, who each have six years experience, have been arrested but won't officially be charged until Friday, Winnipeg police announced Thursday.

"These are serious allegations," Winnipeg police Chief Keith McCaskill told reporters at a news conference. "These are profoundly troubling allegations, and I recognize the impact that allegations like these can have on public confidence."

He said he could not comment further on the case, as it is before the courts.

The pending charges stem from a report of a robbery that came in shortly before 2:45 a.m. CT on July 16, 2007, on Portage Avenue, west of Polo Park shopping centre, police said. A car chase followed, with the officers investigating the call pursuing a man they incorrectly believed to be involved in the robbery.

The two vehicles — the officers' car and the man's vehicle — collided, and the officers proceeded to chase the man on foot near Grant Avenue and Lindsay Street.

That's when the man, Kristofer Shawn Fournier, was shot in his lower body.

Police later determined that Fournier was not involved in the robbery.

He was treated in hospital for his injuries, and has since been released.

The incident triggered a lengthy investigation by the Winnipeg Police Service. The department's findings were forwarded to the Manitoba Department of Justice, which had a private practice lawyer independent of the Crown's office review the file.

After the review, the Justice Department determined that charges should be laid.

One officer has been charged with:

- Attempted murder.
- Fabricating evidence.
- Discharging a firearm with intent to wound.
- Aggravated assault with a weapon.
- Careless use of a weapon.
- Aiding and abetting dangerous operation of a motor vehicle.
- Criminal negligence causing bodily harm.

The second officer has been charged with:

- Fabricating evidence.
- Aiding and abetting discharge of a firearm with intent to wound.
- Aiding and abetting aggravated assault with a weapon.
- Dangerous operation of a motor vehicle.

Under Canada's Criminal Code, a police officer is justified in using force that is likely to cause serious harm, or even death, if all the following conditions are met:

- The officer must be making a lawful arrest.
- The person being arrested must be trying to flee.
- The person being arrested cannot be caught in a less violent manner.
- The officer believes force is necessary to prevent future death or harm.
- The offence for which the person is to be arrested is one for which that person may be arrested without warrant.

The officers will be released from custody on a promise to appear in court, police said. Their first court date is June 1.

The officers have been placed on administrative leave while the police department decides what their future status will be.

The names of the officers will be released Friday.

Their arrest comes on the heels of charges in a separate incident against two other Winnipeg officers.

On March 18, Const. Graeme Beattie and Const. Paul Clark were charged with fabricating evidence, attempting to obstruct justice and public mischief.

The officers are accused of falsifying notes and reports that led to a 20-year-old man being charged with drug trafficking last May.

The case wound its way through the courts for months until the Crown stayed the charges against the man on Oct. 31. An internal police service investigation into the officers' actions was launched in November, resulting in the charges being laid last month.

The mischief charges stem from the alleged falsified reports, which caused police to unnecessarily investigate a drug trafficking offence.

Beattie, 29, and Clark, 40, have both been with the Winnipeg Police Service for three years and were most recently general patrol officers in the North End. They have since been assigned to administrative desk duties pending an internal review to determine their employment status.

They will appear in court May 19 on the charges.

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THIRD PAGE

Thursday, September 2, 2010

City Editor Heather Persson Phone 657-6240 Fax 657-6437

Les MacPherson

B.C. Law Society orders Merchant conduct review

COMMENTARY

It was back in 2007 that a senior British Columbia judge slammed Tony Merchant for “reprehensible” conduct in trying to bill an accident victim for contingency fees.

In his damning decision, Justice Barry Davies of the B.C. Supreme Court further denounced Merchant for the “unethical and obstreperous” pursuit of a “fictitious fee account.” Even worse, the Merchant Law Group “was prepared to offer false evidence to advance its own interests,” Justice Davies found.

He ordered the Merchant firm to pay the victim \$250,400 in damages for breach of fiduciary duty, plus \$50,000 in punitive damages for conduct that was “both outrageous and scandalous,” plus legal costs. The ruling was largely upheld by the B.C. Court of Appeal, which likewise took a dim view of Merchant’s conduct. Invoking in its final ruling last year a precedent that dealt with false evidence, the Appeal Court judgment included the following:

“To give false evidence relating to the matters in question at any stage of the proceedings is a grave matter. By “false,” I do not mean “erroneous;” I mean knowingly un-

true.’ The falsity of Mr. Merchant’s evidence is commented on by the trial judge at several points in his judgment and is referenced by the majority judgment in this court.”

Left unresolved, however, was the matter of Merchant’s professional misconduct. Lawyers are expected to behave ethically. If they don’t, they are subject to discipline from the presiding law society, the independent authority through which lawyers regulate themselves. Merchant has previously been disciplined six times by the Saskatchewan Law Society. The last time was in 2006, when he was suspended for two weeks, fined \$2,500 and ordered to pay more than \$58,000 in costs, for failing to disburse trust funds as ordered by the court in a messy divorce case. Instead, he had disbursed the funds as he saw fit.

In the B.C. case, it is the British Columbia Law Society that has jurisdiction. Last month, more than a year after the case was finally resolved, the society quietly acted. For conduct variously described by the courts as grave and reprehensible, Merchant will be given a stern talking to.

In what the law society calls a conduct review, Merchant is required to meet with two senior lawyers to discuss the problems caused by his conduct and to ensure it will not be

repeated. The review will take place in private, with all the particulars kept secret. It is not a formal hearing. About 70 such conduct reviews were held in B.C. last year.

Merchant’s conduct review will likely be held in Vancouver, at a place and time yet to be specified.

Deborah Armour, the law society’s chief legal officer, said in a telephone interview that Justice Davies’ denunciatory remarks with respect to Merchant’s conduct were handled by the law society only as allegations, not as evidence. Even so, they were serious enough to warrant “an exhaustive investigation.” The results of that investigation went to the society’s disciplinary committee, which ordered the conduct review. If the presiding senior lawyers are satisfied with the review, that likely will be the end of it, at least in B.C.

Not necessarily in Saskatchewan, however.

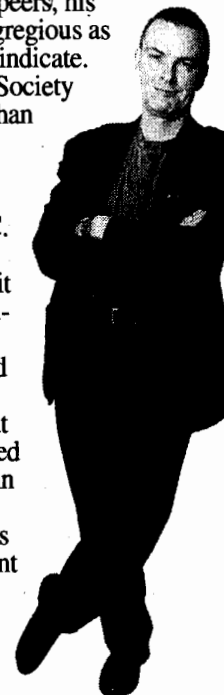
The Saskatchewan Law Society has indicated it would review the case once the B.C. Law Society was finished with it. Further sanctions could be imposed here in light of Merchant’s record in this jurisdiction of six previous violations.

For the public to make sense of this is all but impossible. We don’t know how the B.C. Law Society’s investigation might have

diverged from Justice Davies’ disparaging pronouncements. Maybe, in the view of Merchant’s professional peers, his misconduct was not as egregious as the judge’s ruling would indicate. Or maybe the B.C. Law Society has a different standard than the courts as to what, exactly, is reprehensible.

It doesn’t help appearances that it took the B.C. Law Society took more than a year to act or that it did not as a matter of routine make public its disposition of the case. I had to phone and ask. You’d never know from this that law societies are mandated to act first and foremost in the public interest.

Be that as it may, this is the seventh time Merchant has been disciplined for professional misconduct. It doesn’t seem to be working.



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CRIME

Regina cop suspended, charged with theft

Chief vows to act firmly within weeks

BARB PACHOLIK
THE LEADER-POST

REGINA — Accused of stealing evidence seized in a fraud investigation, a Regina police officer has been suspended from the job and charged criminally for the second time in less than two years.

Const. Darryl G. Blampied, an 11-year member of the service, is charged with theft of a gift card, possession and use of a stolen card, theft under \$5,000 and two counts of possession of stolen property under \$5,000.

"It's not a good day for our police service. I'm very, very disappointed with what I came to know recently," Chief Troy Hagen told a news conference Friday.

The police probe is focused on a \$1,000 Home Depot gift card that was originally seized as part of a fraud investigation almost three years ago when Blampied was a detective in the commercial crime section. Some \$500 worth of purchases were allegedly made with the card.

In addition, it's alleged the officer stole an iPad that was also seized as evidence.

"Both items were in our care within the Regina Police Service," Hagen said.

It's not the first time Blampied, 44, has found himself on the wrong side of the law.

In February last year, he

was fined \$1,200 for driving drunk as he left a bar while off duty. Court heard his breathalyzer reading on Jan. 29, 2012, was .16, or twice the legal limit.

He was also sanctioned by the force after that conviction, receiving a demotion to constable from corporal (a rank he held for less than a month before that offence), placed under "close supervision" for two years, and suspended without pay for 200 hours.

A hearing officer determined the demotion cost the officer about \$7,500 in annual pay, and the suspension about \$7,000.

Released on a recognizance on the newest charges following his arrest Thursday, Blampied is due to make his first court appearance in Regina provincial court on Sept. 9.

"The Regina Police Service is taking this matter extremely seriously," said Hagen.

"Obviously this is not reflective of our organization. We have an excellent organization. I think this demonstrates our transparency."

In September 2010, Regina police officers investigated a fraud case that led to charges against three men accused of attempting to buy large numbers of gift cards with fake debit cards.

A search of an east Regina hotel room, linked to the men, turned up a card reader, laptops, phoney debit cards, cash and a number of gift cards.

Last month after receiving a tip, police discovered a gift card seized in the September 2010 searches had been used some nine times, as recently as this spring.

It's alleged the card was stolen between September 2010 and November 2012.

Hagen said the investigation, including an "administrative review," is ongoing. He said there are no plans to do a complete audit of the thousands of exhibits held by Regina police, but there will be a review of Blampied's "past dealings."

Also under investigation by the service's professional standards branch, Blampied, who most recently worked in the human resources section, has been suspended with pay for up to 30 days, as set out in The Police Act.

Within that time, there will be a hearing to determine if he returns to duty.

The act states that relief from duty with pay continues until the criminal charges are concluded, or

the member is dismissed by the chief of police prior to the disposition of the criminal case.

Hagen said that is "an option that I'm taking very seriously."

He said he hopes to make a decision within the next few weeks.

"I'll act decisively once we have all of our work completed here."

Asked about the integrity of evidence under the control of the police service, Hagen said this situation is an anomaly.

"We have very tight controls regarding exhibits ... They're held in a very secure location, but police officers have access to exhibits when they're associated to a particular file," he said. "The bottom line is, we trust our people."

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GANGS

Lawyer says Hells Angels are law-abiding

**Bikers just
'want to ...
earn a living'**

JASON WARICK
THE STARPHOENIX

Saskatoon members of the Hells Angels are law-abiding citizens with steady jobs and

have no connections to criminal street gangs, the lawyer for the local chapter of the motorcycle club says.

"All they want to do is earn a living," lawyer Morris Bodnar said Thursday.

Bodnar was asked about a recent parole board report and a Saskatoon Police Service inspector linking the Hells Angels with the infamous Terror Squad and other local street gangs.

The parole board report,

which revoked the parole of the Terror Squad's alleged leader, Darren Harper, stated a Terror Squad gang member worked for a potash mine supply company with "direct ties" to an outlaw motorcycle gang.

Saskatoon Insp. Jerome Engele said there are business links between the two groups. Terror Squad members have been involved in home invasions and other violence, as well as trafficking

in cocaine and other drugs.

Bodnar said the Hells Angels who work for the mining supply company make six-figure salaries, so they don't need to do anything illegal to make money.

"They work at the mine. That's it. Whoever goes to visit them, I know nothing about that," Bodnar said.

He said Saskatoon police should spend more time chasing criminals and less time "scripting

their interviews."

"They're just trying to make (Hells Angels) look bad," he said.

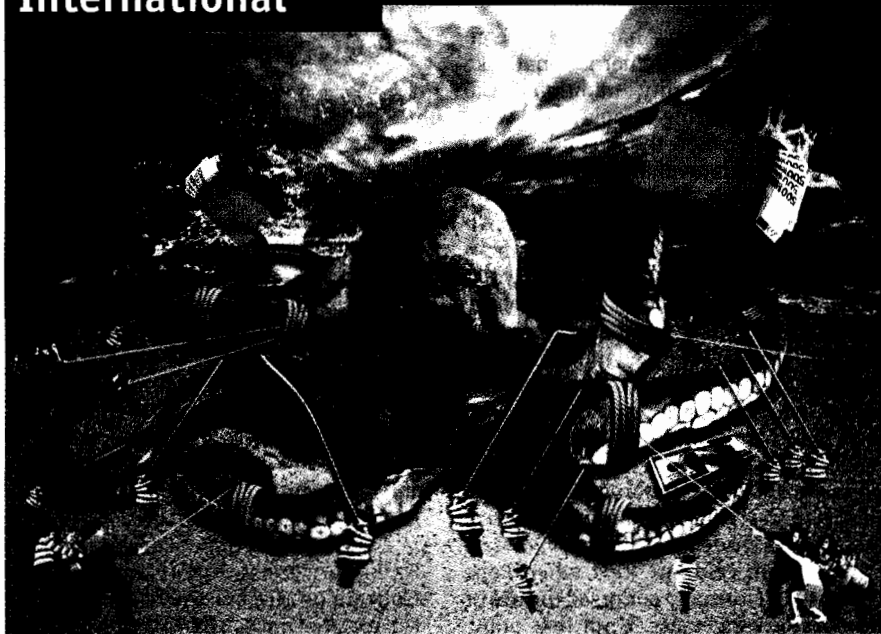
Bodnar has represented the Hells Angels for several years, and has known many of them since their previous incarnations as Rebels and Saxons.

No Hells Angels were available for comment. Calls were made to the Saskatoon clubhouse, listed under Leber Holdings (which is "rebel"

spelled backwards). A man who answered the phone said they "do all our speaking through our lawyer."

In a call to the motorcycle shop owned by the group's alleged leader, a man said, "That's got nothing to do with us, but thanks anyway," before hanging up.

Engele said Thursday he didn't want to respond. He said he was working too hard to be drawn into a pointless argument with Bodnar.



The politics of corruption

Squeezing the sleazy

PRAGUE

Global anti-corruption efforts are growing in scope and clout. This year is set to be the best yet

IMPUNITY and euphemism used to be daunting obstacles for graft-busters. Not any more. International efforts are bearing fruit. New laws have raised the cost of wrongdoing. Financial markets are punishing corrupt companies. Most encouraging, activists have growing clout not only in high-profile cases but at grassroots level, where the internet helps to highlight instances of “quiet” (low-level) corruption.

The big international bodies dealing with corruption are making progress. A working group set up in 2010 by the G20 (the world’s largest economies) has done more than many observers expected, particularly in drawing up rules on seizure of corrupt assets and denial of visas to corrupt officials. Unlike the United Nations Convention Against Corruption, the G20 is not so far split between keen sleaze-busters and countries like Russia and China. Another body, the Paris-based Financial Action Task Force, will start a fourth round of monitoring member states next year, chiefly for effectiveness in implementing anti-money-laundering laws.

Such efforts are “steady, slow boring stuff”, but still important, says Robert Palmer of Global Witness, a campaigning group. He notes that international discussions no longer tiptoe round the word “corruption”. A culture of denial has given way to at least lip-service to the cause.

The anti-graft laws of national governments are making progress too. America’s

Foreign Corrupt Practices Act and Britain’s Bribery Act impose potentially savage penalties on firms that do business by sleazy means. That includes having weak in-house anti-corruption policies. The results are mixed. At a conference earlier this month in Prague organised by the Brookings Institution, an American think-tank, Thomas Firestone of the Moscow office of Baker & McKenzie, a law firm, said foreign managers trying to penalise bribery with dismissal face tough Russian laws that hamper such firings. Perversely, the most corrupt employees can thus gain hefty severance payments. Such clashes between local and international laws abound.

Market pressure is growing too. The International Corporate Governance Network brings together institutional investors with \$18 trillion under management. It scrutinises companies for compliance with anti-corruption principles. So far 70 firms have signed up to the Extractive Industries Transparency Initiative, which aims to make natural-resource companies publish what they pay to governments. America’s Securities and Exchange Commission has backed similar rules. Campaigners say murk around such payments costs poor countries billions of dollars.

Businesses say they like the way clean government creates a level playing-field. In a corrupt country, “you are only as good as your last bribe”, said one executive at the Prague conference. For years, data were

scanty: campaigners relied heavily on the corruption-perceptions index published by Transparency International, an anti-sleaze group. But the 58 countries that support the American-backed Open Government Partnership are committed to providing data about the way public money is spent. That helps to highlight wasteful (and corrupt) government procurement.

Specific campaigns have worked too. Congress has just passed a law blocking the visas and freezing the assets of 60 Russian officials implicated in the death in prison of Sergei Magnitsky, a whistle-blowing lawyer who had uncovered a \$230m fraud. His client, Bill Browder, a financier who is campaigning to avenge him, wants Europe to follow America’s lead.

Lower-profile efforts are spreading too. Not In My Country, a web-based campaign in Uganda, encourages students to report instances of corruption—such as teachers demanding sex for higher grades. Next year it will launch a mobile app for people wanting to upload audio recordings of extortion attempts. Janaagraha, a Bangalore-based group, runs ipaidabribe.com, which has recorded thousands of bribes paid or sought; “heat maps” plot instances of corruption. Similar websites operate in Pakistan, Kenya, Liberia and Indonesia. They help even the humble to fight back.

Tricks of the trade

Given the scale of the problem, nobody is claiming victory. Laws are one thing, enforcement quite another. Public pressure may not create political will among decision-makers. Anti-corruption laws can be politicised and used for partisan purposes. Some countries think that the whole cause is a disguise for Western meddling and hypocrisy. But on December 9th campaigners celebrated International Anti-Corruption Day with a spring in their step. ■

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Free exchange | Fine and punishment

The economics of crime suggests that corporate fines should be even higher

IT HAS been a bumper summer for corporate fines and settlements. In the past three months alone firms in Britain and America have agreed to pay out over \$10 billion because of wrongdoing. But the economics of crime suggests that fines imposed by regulators may need to rise still further if they are to offset the rewards from lawbreaking.

The latest allegations of bad behaviour are a familiar brew of overcharging, mis-selling and price-fixing. Banks have been the worst offenders. Barclays was fined \$450m for its part in a price-fixing scandal; others will follow. HSBC is expected to receive a hefty fine for allegedly flouting money-laundering regulations. Two pharmaceutical firms, GlaxoSmithKline and Abbott Laboratories, have been stung for illegal marketing.

That some firms behave badly is nothing new, but the response of the authorities has changed recently. Take cartels. Internationally, fines rose by a factor of one thousand between the 1990s and 2000s. Data from America suggest this is not because there are more cartel cases, which have shown no upward trend since the late 1980s. Rather, the average level of fines has risen (see left-hand chart). Recent penalties have smashed records. The Barclays fine includes the largest ever levied by Britain's financial regulator and America's Commodity Futures Trading Commission, for instance. Even so, are fines high enough to work?

The economics of crime prevention starts with a depressing assumption: executives simply weigh up all their options, including the illegal ones. Given a risk-free opportunity to mis-sell a product, or form a cartel, they will grab it. Most businesspeople are not this calculating, of course, but the assumption of harsh rationality is a useful way to work out how to deter rule-breakers.

In an influential 1968 paper* on the economics of crime, Gary Becker of the University of Chicago set out a framework in which criminals weigh up the expected costs and benefits of breaking the law. The expected cost of lawless behaviour is the product of two things: the chance of being caught and the severity of the punishment if caught. This framework can be used to examine the appropriate level of fines, and to see if there are ever reasons to exempt companies from fines.

In thinking about how to set fines, it helps to start from the extremes. One option is to have no fines at all for corporate wrongdoing, and to rely instead on market forces to impose the costs that keep firms in line. The market-based approach to antitrust regulation, popularised by Aaron Director of the University of

Chicago, holds that antitrust violations must be ripping someone off, whether a customer or a supplier. The same is true of mis-selling cases. In time a firm acting in this way will lose business, meaning that crime will not pay.

The problem with this view is that frictions—the costs to customers of switching, say, or the barriers to entry for competitors—can allow exploitative firms to escape punishment. Market constraints alone are not always enough to ensure good behaviour. In a 2007 paper, John Connor and Gustav Helmers of Purdue University examined 283 international cartels that operated between 1990 and 2005. The aggregate revenue increase these cartels achieved by acting as they did was over \$300 billion.

At the other extreme is a system of very high fines. Indeed, Mr Becker's crime calculus might lead to the conclusion that fines should be as draconian as possible—seizing all a wrongdoer's assets, for example. Anything lower reduces the expected cost of criminality, without doing anything to improve the probability of detection. (Treating whistleblowers leniently is consistent with this logic: letting them off punishment raises the odds of truth-telling, and therefore of detection.) There are plenty of arguments against ultra-high fines, however. One is that false convictions carry too high a cost. Another is that fines of this sort could cripple firms, reducing competition.

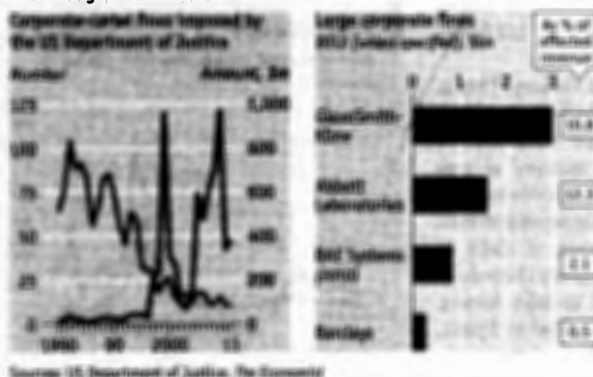
A middle way might be for regulators to levy penalties that offset the benefits of crime. Data on cartels supply useful guidance on how to go about calculating these fines. The first step is to measure the expected gain from crime which fines need to offset. In the study by Messrs Connor and Helmers, the median amount that cartel members overcharged was just over 20% of revenue in affected markets. Next, you need an assumption about the chances of being found out: a detection rate of one cartel in three would mean trustbusters were doing well. In this example, that would mean a fine of 60% of revenue is needed to offset an expected benefit of 20% of revenue—far higher than the fines in the study, which were between 1.4% and 4.9%.

The calculus of crime

Assessed against this methodology, even apparently hefty fines look pretty weak. Recent big penalties (see right-hand chart) have been far lower than a crime calculus of this sort would suggest is needed, even allowing for the fact that some firms, like Barclays, get discounts for co-operating with the authorities. Britain looks particularly lenient. Its antitrust laws impose fines of up to 10% of revenues; American regulators levy penalties of up to 40%, and the European Commission goes up to 30%.

Disgruntled customers may later bring private lawsuits, which can further raise the cost of crime. Here crime economics would suggest the American "class action" system, bunching many customers' complaints into a single lawsuit, is an asset Europe lacks. MasterCard and Visa this month agreed to a \$7.3 billion settlement to resolve retailers' lawsuits alleging collusion (which the two firms deny) over credit-card fees. Criminal charges against individuals can also focus minds. Yet litigation and criminal charges tend to take years to emerge; many wrongdoers are able to avoid court. To deter bad behaviour fines need to rise. The watchdogs are biting, but some need sharper teeth. ■

Penalty kicked



* Studies referenced in this article are available at www.economist.com/fines12

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February 16, 2011

Shy U.S. Intellectual Created Playbook Used in a Revolution

By **SHERYL GAY STOLBERG**

BOSTON — Halfway around the world from Tahrir Square in Cairo, an aging American intellectual shuffles about his cluttered brick row house in a working-class neighborhood here. His name is Gene Sharp. Stoop-shouldered and white-haired at 83, he grows orchids, has yet to master the Internet and hardly seems like a dangerous man.

But for the world's despots, his ideas can be fatal.

Few Americans have heard of Mr. Sharp. But for decades, his practical writings on nonviolent revolution — most notably "From Dictatorship to Democracy," a 93-page guide to toppling autocrats, available for download in 24 languages — have inspired dissidents around the world, including in Burma, Bosnia, Estonia and Zimbabwe, and now Tunisia and Egypt.

When Egypt's April 6 Youth Movement was struggling to recover from a failed effort in 2005, its leaders tossed around "crazy ideas" about bringing down the government, said Ahmed Maher, a leading strategist. They stumbled on Mr. Sharp while examining the Serbian movement Otpor, which he had influenced.

When the nonpartisan International Center on Nonviolent Conflict, which trains democracy activists, slipped into Cairo several years ago to conduct a workshop, among the papers it distributed was Mr. Sharp's "198 Methods of Nonviolent Action," a list of tactics that range from hunger strikes to "protest disrobing" to "disclosing identities of secret agents."

Dalia Ziada, an Egyptian blogger and activist who attended the workshop and later organized similar sessions on her own, said trainees were active in both the Tunisia and Egypt revolts. She said that some activists translated excerpts of Mr. Sharp's work into Arabic, and that his message of "attacking weaknesses of dictators" stuck with them.

Peter Ackerman, a onetime student of Mr. Sharp who founded the nonviolence center and ran the Cairo workshop, cites his former mentor as proof that "ideas have power."

Mr. Sharp, hard-nosed yet exceedingly shy, is careful not to take credit. He is more thinker than revolutionary, though as a young man he participated in lunch-counter sit-ins and spent nine months in a federal prison in Danbury, Conn., as a conscientious objector during the Korean War. He has had no contact with the Egyptian protesters, he said, although he recently learned that the Muslim Brotherhood had "From Dictatorship to Democracy" posted on its Web site.

While seeing the revolution that ousted Hosni Mubarak as a sign of "encouragement," Mr. Sharp said, "The people of Egypt did that — not me."

He has been watching events in Cairo unfold on CNN from his modest house in East Boston, which he bought in 1968 for \$150 plus back taxes.

It doubles as the headquarters of the Albert Einstein Institution, an organization Mr. Sharp founded in 1983 while running seminars at Harvard and teaching political science at what is now the University of Massachusetts at Dartmouth. It consists of him; his assistant, Jamila Raqib, whose family fled Soviet oppression in Afghanistan when she was 5; a part-time office manager and a Golden Retriever mix named Sally. Their office wall sports a bumper sticker that reads "Gotov Je!" — Serbian for "He is finished!"

In this era of Twitter revolutionaries, the Internet holds little allure for Mr. Sharp. He is not on Facebook and does not venture onto the Einstein Web site. ("I should," he said apologetically.) If he must send e-mail, he consults a handwritten note Ms. Raqib has taped to the doorjamb near his state-of-the-art Macintosh computer in a study overflowing with books and papers. "To open a blank e-mail," it reads, "click once on icon that says 'new' at top of window."

Some people suspect Mr. Sharp of being a closet peacenik and a lefty — in the 1950s, he wrote for a publication called "Peace News" and he once worked as personal secretary to A. J. Muste, a noted labor union activist and pacifist — but he insists that he outgrew his own early pacifism and describes himself as "trans-partisan."

Based on studies of revolutionaries like Gandhi, nonviolent uprisings, civil rights struggles, economic boycotts and the like, he has concluded that advancing freedom takes careful strategy and meticulous planning, advice that Ms. Ziada said resonated among youth leaders in Egypt. Peaceful protest is best, he says — not for any moral reason, but because violence provokes autocrats to crack down. "If you fight with violence," Mr. Sharp said, "you are fighting with your enemy's best weapon, and you may be a brave but dead hero."

Autocrats abhor Mr. Sharp. In 2007, President Hugo Chávez of Venezuela denounced him, and officials in Myanmar, according to diplomatic cables obtained by the anti-secrecy group WikiLeaks, accused him of being part of a conspiracy to set off demonstrations intended "to bring down the government." (A year earlier, a cable from the United States Embassy in Damascus noted that Syrian dissidents had trained in nonviolence by reading Mr.

Sharp's writings.)

In 2008, Iran featured Mr. Sharp, along with Senator [John McCain](#) of Arizona and the Democratic financier [George Soros](#), in an animated propaganda video that accused Mr. Sharp of being the [C.I.A.](#) agent "in charge of America's infiltration into other countries," an assertion his fellow scholars find ludicrous.

"He is generally considered the father of the whole field of the study of strategic nonviolent action," said Stephen Zunes, an expert in that field at the University of San Francisco. "Some of these exaggerated stories of him going around the world and starting revolutions and leading mobs, what a joke. He's much more into doing the research and the theoretical work than he is in disseminating it."

That is not to say Mr. Sharp has not seen any action. In 1989, he flew to China to witness the uprising in Tiananmen Square. In the early 1990s, he sneaked into a rebel camp in Myanmar at the invitation of Robert L. Helvey, a retired Army colonel who advised the opposition there. They met when Colonel Helvey was on a fellowship at Harvard; the military man thought the professor had ideas that could avoid war. "Here we were in this jungle, reading Gene Sharp's work by candlelight," Colonel Helvey recalled. "This guy has tremendous insight into society and the dynamics of social power."

Not everyone is so impressed. As'ad AbuKhalil, a Lebanese political scientist and founder of the [Angry Arab News Service blog](#), was outraged by a passing mention of Mr. Sharp in The New York Times on Monday. He complained that Western journalists were looking for a "Lawrence of Arabia" to explain Egyptians' success, in a colonialist attempt to deny credit to Egyptians.

Still, just as Mr. Sharp's profile seems to be expanding, his institute is contracting.

Mr. Ackerman, who became wealthy as an investment banker after studying under Mr. Sharp, contributed millions of dollars and kept it afloat for years. But about a decade ago, Mr. Ackerman wanted to disseminate Mr. Sharp's ideas more aggressively, as well as his own. He put his money into his own center, which also produces movies and even a video game to train dissidents. An annuity he purchased still helps pay Mr. Sharp's salary.

In the twilight of his career, Mr. Sharp, who never married, is slowing down. His voice trembles and his blue eyes grow watery when he is tired; he gave up driving after a recent accident. He does his own grocery shopping; his assistant, Ms. Raqib, tries to follow him when it is icy. He does not like it.

He says his work is far from done. He has just submitted a manuscript for a new book, "Sharp's Dictionary of Power and Struggle: Terminology of Civil Resistance in Conflicts," to be published this fall by Oxford University Press. He would like readers to know he did not pick the title. "It's a little immodest," he said. He has another manuscript in the works about Einstein, whose own concerns about totalitarianism prompted Mr. Sharp to adopt the scientist's name for his institution. (Einstein wrote the foreword to Mr. Sharp's first book, about Gandhi.)

In the meantime, he is keeping a close eye on the Middle East. He was struck by the Egyptian protesters' discipline in remaining peaceful, and especially by their lack of fear. "That is straight out of Gandhi," Mr. Sharp said. "If people are not afraid of the dictatorship, that dictatorship is in big trouble."

Andrew W. Lehren contributed reporting from New York, and David D. Kirkpatrick from Cairo.

This article has been revised to reflect the following correction:

Correction: February 19, 2011

An article on Thursday about Gene Sharp, the author of a treatise on toppling autocrats, misspelled the surname of his assistant at the Albert Einstein Institution, which he founded. She is Jamila Raqib, not Raquib.

4
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SASKATOON
61 miles at 195 degrees to
Accident site.

Hourly Data Report for November 16, 1992

	<u>Temp</u> °C	<u>Dew</u> <u>Point</u> <u>Temp</u> °C	<u>Rel</u> <u>Hum</u> %	<u>Wind</u> <u>Dir</u> <u>10's</u> <u>deg</u>	<u>Wind</u> <u>Spd</u> km/h	<u>Visibility</u> km	<u>Stn</u> <u>Press</u> kPa	<u>Hmdx</u>	<u>Wind</u> <u>Chill</u>	<u>Weather</u>
TIME										
00:00	-6.4	-7.2	94	35	9	0.8	95.46		-11	Fog
01:00	-4.7	-5.5	94	18	4	8.0	95.46		-6	Fog
02:00	-3.9	-4.5	95	23	6	9.7	95.46		-7	Fog
03:00	-3.5	-4.4	94	25	6	12.9	95.52		-6	Cloudy
04:00	-2.8	-3.9	92	27	7	16.1	95.52		-6	Cloudy
05:00	-2.4	-3.5	92	26	6	19.3	95.52		-5	Cloudy
06:00	-2.0	-3.2	91	27	7	19.3	95.59		-5	Cloudy
07:00	-1.5	-2.8	91	25	6	19.3	95.59		-4	Cloudy
08:00	-1.2	-2.5	91	28	7	19.3	95.62		-4	Cloudy
09:00	-1.0	-2.2	91	28	6	16.1	95.65		-3	Cloudy
10:00	0.0	-1.5	90	25	6	19.3	95.65		-2	Mostly Cloudy
11:00	1.3	-1.0	85	22	7	24.1	95.68			Cloudy
12:00	1.9	-0.6	83	26	13	24.1	95.72			Cloudy
13:00	2.1	-0.4	83	25	13	24.1	95.72			Cloudy
14:00	2.6	-0.1	82	24	11	24.1	95.72			Cloudy
15:00	3.0	-0.2	79	27	9	24.1	95.72			Cloudy
16:00	3.2	0.0	79	28	4	24.1	95.72			Mostly Cloudy
17:00	2.1	-0.4	83	23	4	24.1	95.72			Mostly Cloudy
18:00	1.5	-0.5	87	26	15	24.1	95.75			Mostly Cloudy
19:00	0.5	-0.9	90	27	7	24.1	95.78			Mostly Cloudy
20:00	0.4	-0.9	91	26	9	19.3	95.81			Cloudy
21:00	0.6	-0.5	92	25	6	16.1	95.81			Cloudy
22:00	0.6	-1.2	87	28	15	16.1	95.85			Cloudy

	<u>Temp</u> °C	<u>Dew</u> <u>Point</u> <u>Temp</u> °C	<u>Rel</u> <u>Hum</u> %	<u>Wind</u> <u>Dir</u> <u>10's</u> <u>deg</u>	<u>Wind</u> <u>Spd</u> km/h	<u>Visibility</u> km	<u>Stn</u> <u>Press</u> kPa	<u>Hmdx</u>	<u>Wind</u> <u>Chill</u>	<u>Weather</u>
23:00	-0.2	-1.7	90	27	9	16.1	95.88		-3	Cloudy

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Notes on Data Quality.

Legend

- M = Missing
- E = Estimated
- NA = Not Available
- ‡ = Partner data that is not subject to review by the National Climate Archives

Date modified: 2013-07-10

Prediction of hoar-frost by use of a Road Weather information System

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This study measured the amount of hoar-frost on the road surface with the help of copper plates. The amounts were compared to data collected at a station in the Road Weather information System (RWIS) together with additional measurements of the temperature and humidity profile above the road surface. The data were used to specify the weather parameters when hoar-frost forms on the road surface and relate the measured amount of hoar-frost and resulting friction to measured weather parameters. The aim was also to see whether there was an increased possibility of predicting the amount of hoar-frost with additional measurements of the temperature and humidity profiles. The results of this study confirm that the amount of hoar-frost deposited on the road surface increases with increasing average wind speed, increasing maximum difference between dew point (T_d) and road surface temperature (T_r) and increased duration when $T_r < T_d$, measured at the RWIS station. However, the difference between T_d and T_r failed to indicate hoar-frost on several occasions due to the location and poor accuracy of the measuring equipment. Measurements of temperature and humidity in a profile up to 2.5 m above the road surface showed that the air layer up to 0.4 m reflected conditions at the road surface whereas the surrounding areas influenced the measurements at higher levels. A forward multiple regression performed on the data showed that measurements of temperature and humidity at lower levels improved predictions of deposition of hoar-frost on the road surface. Measurements of friction on the road surface when hoar-frost was present showed that friction decreased with increasing difference between T_d and T_r and it also increased with the duration of $T_r < T_d$. There was no correlation between the amount of hoar-frost and friction at the road surface. The friction is probably influenced not only by the amount of hoar-frost but also by the structure of the hoar-frost, which has not been determined in this study.

1. Introduction

Hoar-frost forming on the road surface is one type of slipperiness that is hard to predict both in amount deposited and in the resulting friction reduction. Theoretically hoar-frost is water vapour sublimating on the road surface when the temperature is below zero and the dew point temperature is higher than the road surface temperature. Hoar-frost deposition on roads was studied by Hewson & Gait (1992) who used physical reasoning and case studies to develop two methods of predicting the formation of hoar-frost. Gustavsson & Bogren (1990a) studied temperature differences between road surface and dew point and their relationship to hoar-frost occurring during the passage of a warm front. Hoar-frost also commonly forms on the road surface when the road surface cools more quickly than the air layer above. The amount of hoar-frost formed is usually higher during the former situation (Kromer, 1995). Takle (1990) used a survey of frost occurrence from the highway maintenance people in order to describe the occasions when hoar-frost formed. In a study of climatic mapping of ice loads, Makkonen & Ahti (1995) used airport weather obser-

vations to describe the distribution of rime in different terrains.

Factors important for the development of hoar-frost are discussed in several articles.

- (a) Wind speed, air temperature and humidity are considered the most important factors by several authors (e.g. Gocheva, 1990; Scherm & Van Bruggen, 1993; Stanev *et al.*, 1987; Hewson & Gait, 1992).
- (b) Scherm & Van Bruggen (1993) maintains that fractional cloud cover is important for the duration of hoar-frost events.
- (c) Stanev *et al.* (1987) includes wind direction and Hewson & Gait (1992) the time of year as being important.
- (d) Makkonen & Ahti (1995) and Stanev *et al.* (1987) mention the importance that the duration of the event has on the amount of hoar-frost.
- (e) Takle (1990), Hewson & Gait (1992) and Gustavsson & Bogren (1990a) add that the preceding weather has an effect on the amount of hoar-frost.

- (f) Gustavsson & Bogren (1990a) also proposed that the size of the temperature difference between road surface temperature (T_r) and dew point temperature (T_d) could be proportional to the amount of hoar-frost deposited.
- (g) Gustavsson (1991) studied the importance of local climate variation for the duration and amount of hoar-frost.

The Road Weather information System (RWiS) in Sweden uses measurements of air temperature and humidity at 2 m, wind speed at 5 m and road surface temperature to generate warnings of hoar-frost deposition on the road surface. Studies of temperature variation in the air layer close to the road surface have shown that large temperature differences in that layer occur especially during weather situations when hoar-frost usually develops (Chen *et al.*, 1999; Karlsson, 1999). With large temperature and humidity differences in the air layer close to the road surface the warnings generated from measurements at 2 m can sometimes be misleading.

The aim of this study is to analyse the importance of temperature variations in the air layer close to the road surface for the formation of hoar-frost. The following specific points are dealt with.

- (a) The amount of hoar-frost produced during different weather situations.
- (b) The weather situations when hoar-frost forms on the road surface.
- (c) The correlation between amount of hoar-frost and friction to the measured weather parameters.
- (d) The height of the air layer that reflects the processes close to the road surface.
- (e) Improving hoar-frost prediction with additional measurements of temperature and humidity profiles.

2. Study area and instrumentation

2.1. Measurements

The measurements described in this paper were performed during three winter seasons from 1996 to 1999.

They were taken at the Swedish National Road Administration test site at Road 45 near Göteborg. The test site is situated alongside a section of a four-lane highway at Surte and it comprises an asphalt plane approximately 30 m long and 10 m wide in contact with one lane of the highway. The site is equipped with a monitoring system which measures temperature, humidity, wind speed and wind direction at several levels. New measuring equipment is tested at the site and an original RWiS station is also present.

For this project data from the RWiS station were used together with data from additional equipment measuring temperature and humidity in a profile above the road up to 2.5 m. The additional equipment took measurements every 10 seconds and stored them as an average in a logger every 10 minutes. Measuring levels and instrument data are shown in Table 1. Before and after each measuring season the temperature and humidity instruments were calibrated.

The RWiS data were used to analyse the relationship between parameters measured at the RWiS station and the amount of hoar-frost deposited on the road surface. The additional equipment, measuring temperature and humidity profiles, were used to analyse whether the measuring of additional parameters at the RWiS station could improve the prediction of hoar-frost on the road surface.

To obtain an estimate of the amount of hoar-frost deposited at the road surface, hoar-frost was measured at three locations with the help of thin copper plates. The amounts from the three plates were then averaged. The plates measured 15 cm × 20 cm × 0.05 cm and were painted black in order to produce a similar emissivity to the road surface. The plates were weighed to calculate the amount of hoar-frost deposited. The structure of the hoar-frost and its distribution on the road surface were also visually observed on each occasion.

A portable skid resistance tester, developed at the Swedish National Road and Traffic Research Institute (Gustafsson, 1981), measured the friction at the road surface on some occasions when hoar-frost was present.

Table 1. Instrument specifications for measuring equipment

Measurement	Level (m)	Time constant	Accuracy	Range	Sampling frequency	Instrument
RWiS						
Air temperature	2	—	± 0.3 °C	−60 to +70 °C	30 min	Lambrecht 8091
Humidity	2	—	± 3%	5 to 100%	30 min	Lambrecht 8091
Wind speed	5	—	± 0.2 m s ^{−1}	0.4 to 75 m s ^{−1}	30 min	Vaisala, WAA15
Wind direction	5	—	± 11.75°	0 to 360°	30 min	Vaisala, WAV15
Road surface temperature	−0.002	—	± 0.3 °C	−60 to +70 °C	30 min	Pt 100
Road mast						
Temperature	0.1, 0.4, 1.0, 1.5, 2.5	< 10 s	± 0.1 °C	—	10 min	Thermistor
Humidity	0.1, 0.4, 1.0, 2.5	15 s (90%)	± 0.5%	0 to 100%	10 min	Vaisala, HMP 243

sent. The skid resistance is given as a friction coefficient between the frictional force and the normal force. The friction coefficient is non-dimensional but due to the low number of the coefficient it is usually given in μ (10^{-6}).

2.2. Measuring accuracy

Differences in emissivity and thermal properties between the copper plates and the road surface result in different cooling patterns which means that the amounts of hoar-frost measured on the copper plates cannot be directly used for estimations on the road surface. Observations showed, however, that the distribution and structure of the hoar-frost on the copper plates and on the road surface were similar. Hoar-frost was present on the asphalt surface on each occasion when hoar-frost was measured on the copper plates. The variation in amount of hoar-frost between the plates was approximately $\pm 40 \text{ g m}^{-2}$.

Plates are commonly used in crop research to measure the amount of dew on the ground and at different levels, see Jacobs *et al.* (1994). Kidron (1997) showed that plates larger than $30 \text{ cm} \times 30 \text{ cm}$ created their own microclimate resulting in larger amounts of dew and plates smaller than $5 \text{ cm} \times 5 \text{ cm}$ received smaller amounts due to the impact of soil thermal properties. The choice of plates measuring $15 \text{ cm} \times 20 \text{ cm}$ in this study corresponded quite well to the amount of hoar-frost formed on the road surface (visual estimate). The plate was very thin (0.5 mm) and the high thermal capacity of copper results in a quick adjustment to the temperature of the underlying surface. The use of plates was a good alternative to other expensive measuring devices available and it also had the advantage that the amount of hoar-frost was confirmed with visual observations.

To measure the relatively small differences in temperature between levels requires instruments which are well calibrated with each other. The instruments used in this study had an accuracy of $\pm 0.1^\circ\text{C}$. A calibration performed in a climate chamber showed a maximum difference between instruments of 0.2°C . The temperature recordings at different levels showed nearly equal temperature development during cloudy and windy situations. This indicates that the differences of up to 1.7°C between different measuring levels in this study were accurate and not related to measuring errors.

The instrument used for measuring wind speed in this study has a starting value of 0.4 m s^{-1} . The wind speed is measured every second and then averaged for each 10-minute period. At very low wind speeds this results in the measured average wind speed possibly being lower than the actual average wind speed.

3. Results and discussion

3.1. Weather situations during formation of hoar-frost

Hoar-frost was measured on 16 selected nights during the study period. Earlier studies by Hewson & Gait (1992) and Gustavsson & Bogren (1990a) showed that hoar-frost especially tends to form during two weather situations. The most common is during clear nights when the surface cools below dew point. The other situation is when a warm front passes and low air temperatures are replaced with warm air by advection; the road surface temperature then rises more slowly and stays below the dew point. Examples of the temperature development and wind speed during these types of situations are shown in Figure 1. The examples are taken from two consecutive days where the first is a clear and calm night and the following night is clear followed by warm air advection. During the first night, 26/27 January 1997, the wind speed varied between 1 and 3 m s^{-1} , the sky was clear and the road surface had cooled to below dew point (Figure 1(a)). During the second night, 27/28 January 1997, the sky was also clear and the wind speed was lower than 3 m s^{-1} but warm air advection increased the air temperature although the road surface had cooled below dew point (Figure 1(b)). On both these occasions large amounts of hoar-frost were measured in the early morning hours.

In this study, hoar-frost was measured on 13 occasions when there was cooling of both the air and road surface temperatures, and on 3 occasions when warm air advection increased the air temperature whilst the road surface temperature continued to cool for a few hours. The weather conditions for these occasions are shown in Table 2. The sky was clear with cloud cover less than 2 oktas during some part of the night for all situations. The intense cooling on clear calm nights increases the risk of hoar-frost and when this weather is followed by warm air advection the temperature differences between road and air increases thus increasing the risk of slipperiness (Gustavsson, 1991). The average wind speed was below 3 m s^{-1} for all situations. The minimum road surface temperature ranged from -2.2 to -12.2°C and the minimum air temperature varied from -1.2 to -14.3°C .

The RWiS uses a simplified procedure to determine the flow of water vapour to the road surface. One criteria for the sublimation of hoar-frost is that the temperature difference between dew point (T_d) and road surface temperature (T_r) is positive. When comparing the recordings from RWiS and manual observations of hoar-frost in Table 2, it can be seen that the maximum difference between T_d and T_r , with dew points calculated from RWiS measurements at 2 m, is negative on several occasions when hoar-frost is observed and measured on the road surface. A large humidity and temperature difference in the air layer below the measuring

Table 2. Weather description for situations when hoar-frost was measured, X indicates that the cloud cover was less than 2/8, Y = hoar-frost indicated by RWIS, N = Hoar-frost not indicated by RWIS. All values consider the whole night hour value.

Level	Cloud cover <2/8	Average wind speed (m s ⁻¹)	Min T_r (°C)	Min T_a (°C)	Max $T_d - T_r$ (°C)	Max $T_a - T_r$ (°C)	Temperature difference 2.5–0.1 m (°C)	Hoar-frost (g m ⁻²)	R
<i>Cooling</i>									
24 Jan 1997	X	0.59	-5.1	-4.0	-0.6	1.1	1.3	-	
27 Jan 1997a	X	1.66	-4.25	-2.2	2.1	2.3	0.9	181	
27 Jan 1997b	X	2.73	-2.9	-1.2	0.8	1.5	0.3	24	
29 Jan 1997	X	0.31	-3.3	-3.3	2.5	3.0	1.5	210	
30 Jan 1997	X	1.05	-2.3	-2.3	0.4	0.5	0.8	209	
31 Jan 1997	X	1.51	-4.7	-4.7	1.5	3.9	1.4	297	
27 Nov 1997	X	Missing	Missing	Missing	Missing	Missing	Missing	85	Mi
18 Dec 1997	X	0.90	-8.9	-8.0	-0.4	2.0	-	55	
19 Dec 1997	X	1.27	-9.3	-9.0	-0.2	0.7	-	75	
22 Jan 1998	X	0.64	-9.5	-10.6	-1.7	0.9	1.0	132	
29 Jan 1998	X	0.15	-7.5	-9.1	-1.9	1.5	1.7	82	
17 Feb 1998	X	1.39	-3.5	-4.0	-1.7	0.7	1.3	186	
30 Jan 1999	X	0.11	-12.2	-12.6	-0.8	1.5	-	82	
11 Feb 1999	X	0.23	-9.4	-10.8	-0.1	0.6	0.5*	120	
<i>Warming</i>									
28 Jan 1997	X	1.71	-2.2	-0.5	1.8	5.7	1.2	495	
29 Jan 1999	X	0.79	-11.2	-14.3	-2.3	-1.0	-	115	
12 Feb 1999	X	0.99	-5.6	-5.0	1.9	2.6	1.4*	94	

* Temperature difference over the distance 1 m to 0.1 m.

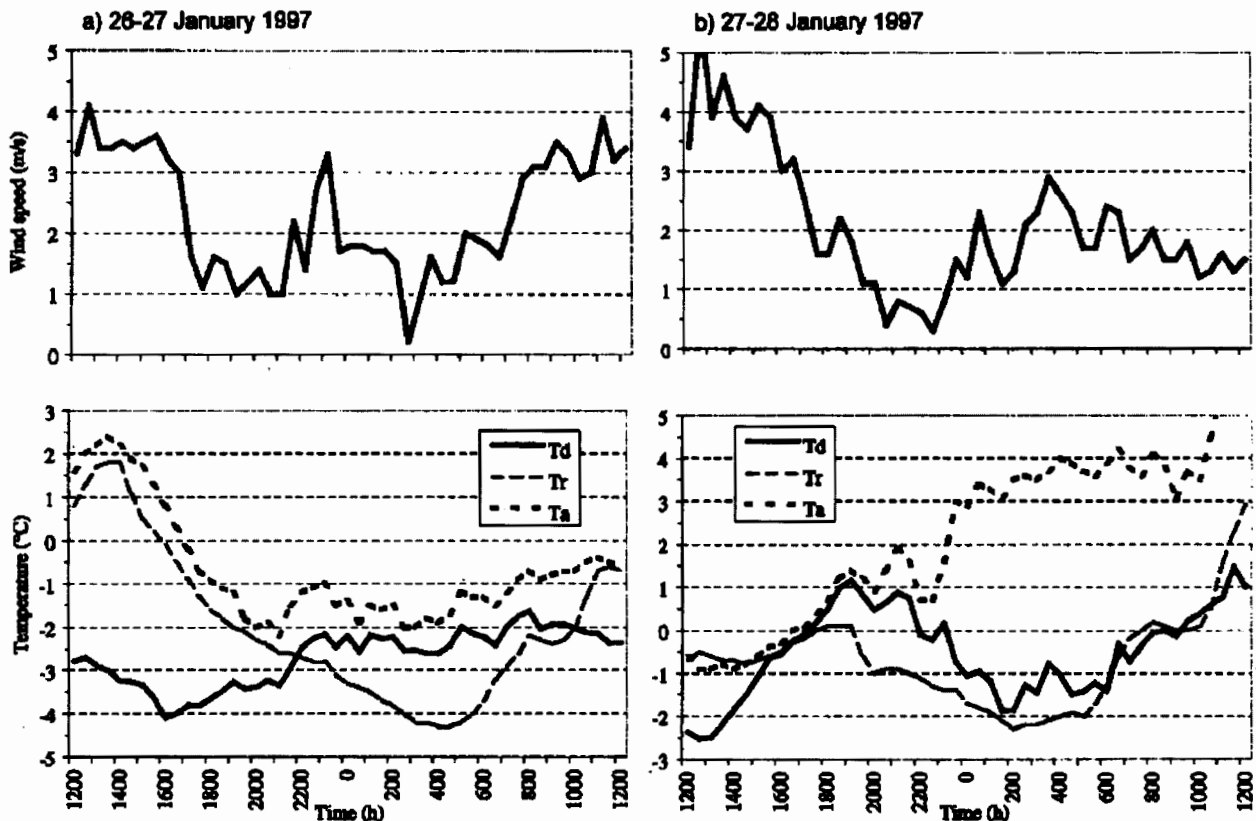


Figure 1. Temperature development and wind speed during two typical situations when hoar-frost sublimates on the road surface. (a) A cooling situation where the road surface cools more than the air. (b) A warming situation where the air temperature is increased whereas the road temperature is lowered. On both occasions the road surface temperature is lowered below the dew point.

height at 2 m makes it difficult to predict hoar-frost on the road surface. The maximum temperature difference between the air and the road surface is positive for all occasions except one. Maximum air temperature gradients shows that there was an inversion in the lowest air layers on all occasions.

3.2. Methods for predicting hoar-frost

Several different methods are used to predict the presence and amount of hoar-frost deposited. As mentioned earlier the National Road Administration in Sweden uses a simplified procedure with data from RWIS stations to warn of hoar-frost on the road surface. The criterion for the dew point temperature is lowered accordingly to avoid warnings of light hoar-frost or inadequate measuring accuracy:

$$T_r < 0^\circ\text{C}, T_d - T_r > 0.5^\circ\text{C} \text{ and wind speed} > 2 \text{ m s}^{-1}$$

$$T_r < 0^\circ\text{C} \text{ and } T_d - T_r > 1^\circ\text{C} \text{ when wind speed} < 2 \text{ m s}^{-1}$$

The warnings should be considered as an aid for the maintenance crew to decide whether or not to take action against slipperiness. Hewson & Gait (1992) used two different methods to predict the amount of hoar-frost. The first method was a checklist of factors which increase the risk of hoar-frost. The factors were clear

skies, small dew point depression, high dew points, strong winds, cold and clear conditions the preceding night, low road-bed temperature and a long night. The second method multiplied the area between T_r and T_d , in a graph, with the average wind speed (U in m s^{-1} where 1 unit is added to the average to account for the stirring caused by traffic, i.e. $U^* = U + 1 \text{ m s}^{-1}$). According to their results this figure was roughly proportional to the depth of hoar-frost.

In this project the methods presented above were tested to determine their hit rate for the days when hoar-frost was observed (Table 2). The RWIS method and Method 2 of Hewson & Gait is based on the difference between T_d and T_r , therefore they could not predict the hoar-frost for the occasions when the $T_d - T_r$ was negative (Table 2). It should be noted that the RWIS method is only supposed to give a warning when hoar-frost is present in amounts large enough to require salting or gritting to prevent slipperiness. Even so, the method still failed on some occasions to warn when large amounts of hoar-frost were present on the road surface. Method 1 of Hewson & Gait, where higher numbers indicates increased risk of hoar-frost, shows no correlation to the measured amount of hoar-frost shown in Table 2. This indicates clearly that there is a need for improvement in the methods used to predict the amount of hoar-frost deposited on the road surface.

The following sections deal with the cause for the discrepancy between measured and predicted hoar-frost and how measurements can be improved.

3.3. Amount of hoar-frost related to meteorological parameters

Figure 2 shows the correlation between measured hoar-frost and factors measured at the RWiS station that are mentioned as important in the literature. Factors shown in Figure 2 are average wind speed, minimum T_r , maximum difference between T_d and T_r and the

duration of road surface temperature below dew point. Maximum difference between T_a and T_r and the time period with a positive difference are also shown. In the figure it can be seen that the amount of hoar-frost increases with increasing wind speed. The increase in wind speed results in more turbulence and transportation of humidity to the road surface. There is a breakpoint when increased turbulence and resulting smaller temperature differences reduce the deposition of hoar-frost (Gocheva 1990). High minimum T_r increases the amount of hoar-frost due to the non-linear correlation between temperature and saturation vapour pressure. A temperature decrease at higher temperatures results

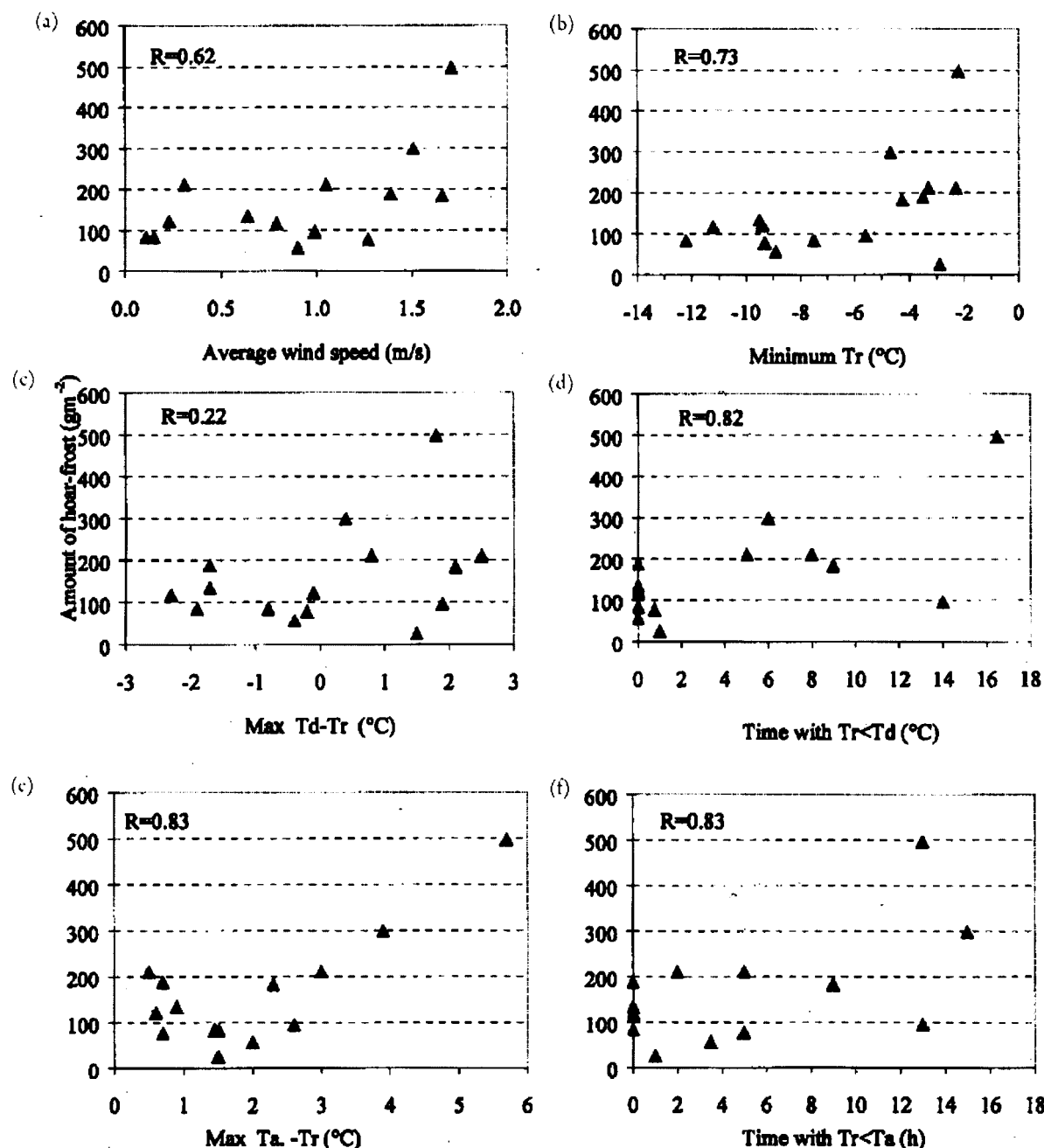


Figure 2. Amount of hoar-frost correlated to parameters important for the development of hoar-frost. (a) Average wind speed during the night. (b) Minimum T_r . (c) Maximum temperature difference between T_d and T_r . (d) Time with a positive difference in $T_d - T_r$. (e) Maximum temperature difference between T_a and T_r . (f) Time with temperature difference between $T_a - T_r$.

in more humidity available for sublimation. The amount increases up to 0 °C where the sublimation changes to dew deposition. The maximum difference between dew point and T_r shows a tendency for the amount of hoar-frost to increase with increased difference, but the fit is better when the difference between T_a and T_r is used. The duration of a temperature difference, either $T_d - T_r$ or $T_a - T_r$ indicates an increasing amount of hoar-frost with increasing time.

On some occasions the friction at the road surface was measured. These results are shown in Figure 3. The friction against the road surface during hoar-frost events decreased with increased temperature difference between T_d and T_r . The friction also decreased with increasing time with temperature difference between air temperature and T_r . There is a very small correlation

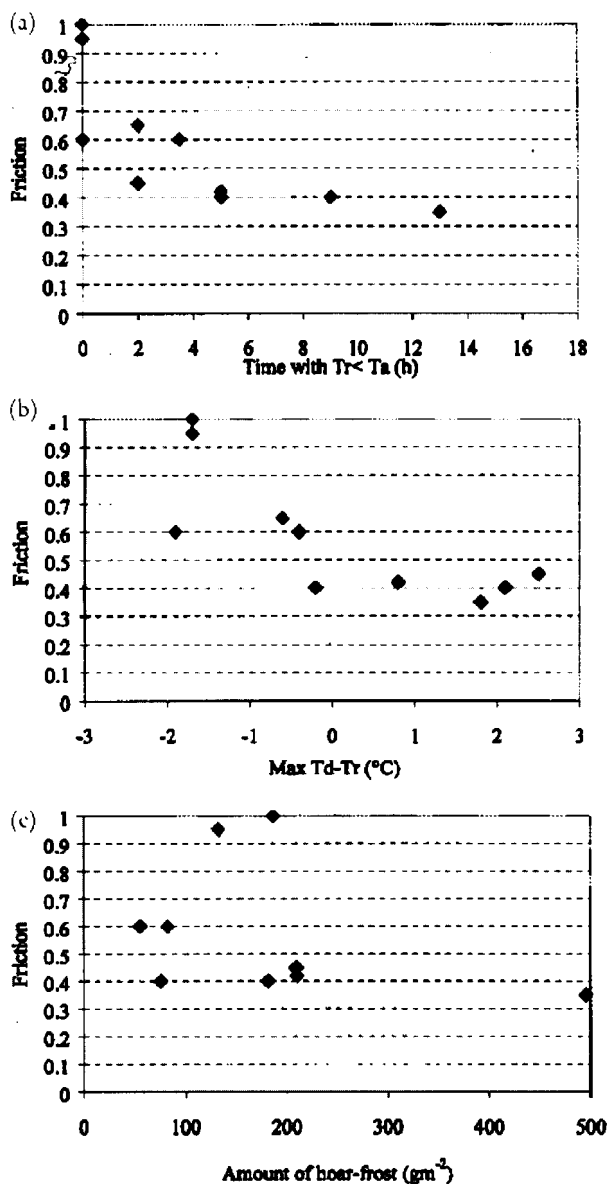


Figure 3. Friction at the road surface correlated to (a) time with temperature difference between T_a and T_r , (b) maximum difference between $T_d - T_r$ and (c) amount of hoar-frost. Skid friction in μ

between amount of hoar-frost and friction. The largest amount of hoar-frost receives the smallest friction but with lower amounts of hoar-frost the friction is well scattered and is probably determined by the hoar-frost structure.

3.4. Temperature and humidity gradient close to the road surface during hoar-frost situations

Hoar-frost is theoretically formed when the T_r is below 0 °C, T_r is below the dew point and there is a flow of humid air towards the road surface. However, the results in Figure 2 and Table 2 show that the difference between T_d and T_r fails to indicate hoar-frost on some occasions. There could be several reasons for this, most of them related to the measuring technique at the RWIS station. A study by Bergendahl (1998) showed that the T_r could differ by up to 2.6 °C between measurements made with the infrared technique and a probe situated 2 mm below the road surface. Measurements with IR-techniques have also shown that the road surface temperature can vary by up to 1.5 °C across the road (Gustavsson & Bogren, 1990b). Karlsson (1999) showed that the temperature during occasions with hoar-frost could differ by up to 1.7 °C between measurements at 2.5 m and 0.1 m above the road surface. Depending on the measuring equipment or their location, these differences in temperature are probably the reason why hoar-frost could not be predicted on all occasions.

The air layer affected by the surface processes can be determined from temperature and humidity profile measurements taken above the road. These were measured at three levels, 0.1 m, 1.0 m and 2.5 m from January to May 1998, and at 0.1 m, 0.4 m and 1 m during January and February 1999. Results from two occasions when hoar-frost developed on the road surface are shown in Figure 4. The measurements from 29 January 1998 when temperature and humidity were measured up to 2.5 m showed that the temperature increased vertically to 1 m above the road surface by a maximum of 2.2 °C m^{-1} and thereafter decreased by a maximum of 0.47 °C m^{-1} (Figure 4(a)). These temperature gradients can be compared with Figure 4(b) where the profiles were measured up to 1 m on 12 February 1999. There it is seen that the increase in temperature and absolute humidity is between 0.4 m and 1 m, with a maximum temperature gradient of 1.5 °C m^{-1} and only 1 °C m^{-1} between 0.1 and 0.4 m. Humidity profiles show the same pattern. Measurements of temperature and humidity close to the surface reflect the surface processes better and are therefore able to predict more accurately the amount of hoar-frost. It is, however, impractical to measure too close to the road surface owing to spray from the traffic and the likelihood of equipment being covered during snowfalls. However, the results show that measurements up to 0.4 m could be used to represent the con-

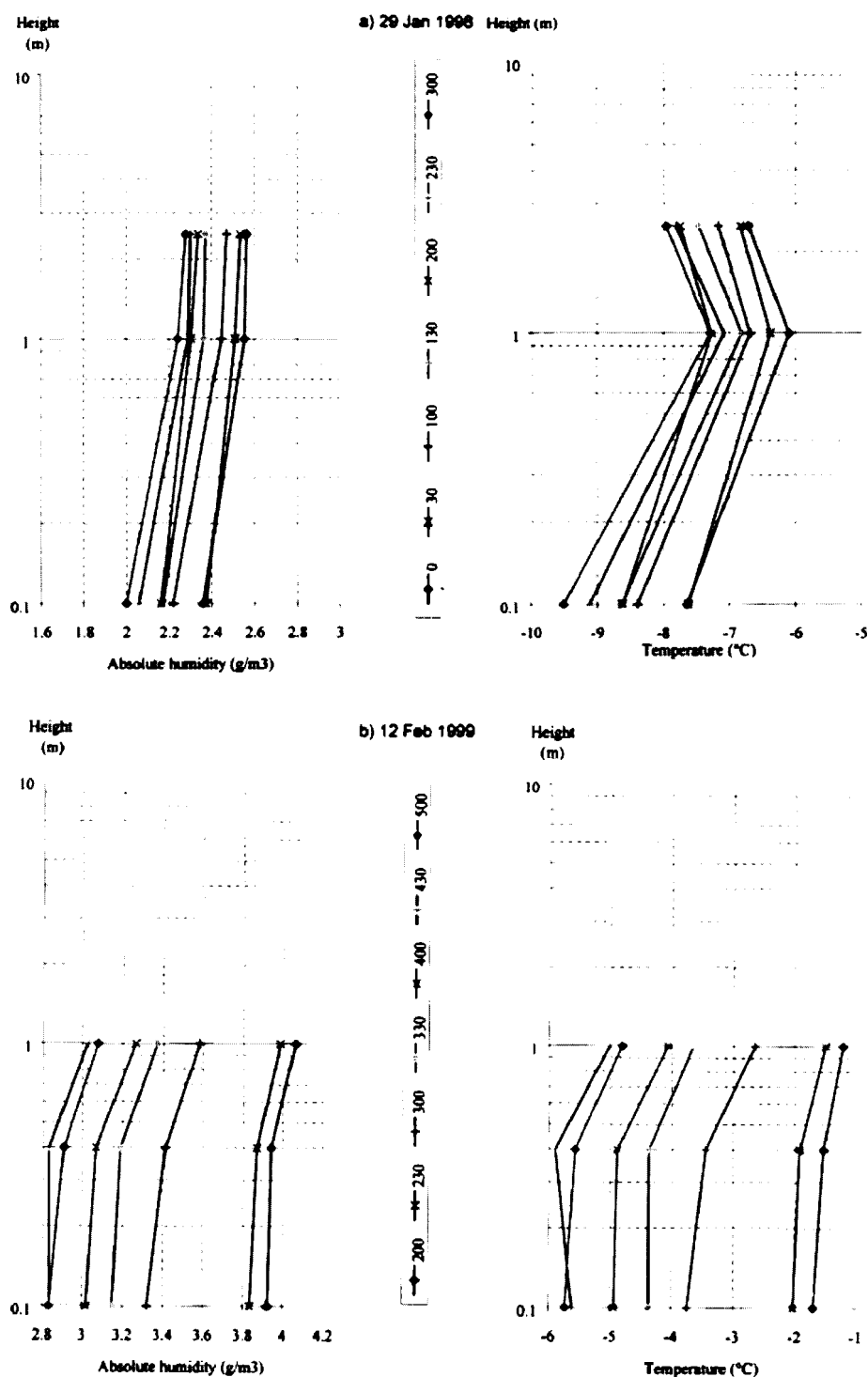


Figure 4. Temperature and absolute humidity profiles above the road surface for two occasions when hoar-frost develops on the road surface. (a) 29 January 1998 profile measured at three levels up to 2.5 m. (b) 12 February 1999 profile measured at three levels up to 1 m.

ditions close to the road surface better than those measurements taken at 2 m. Measurements at a height of 0.4 m are also less affected by spray from the road surface than measurements at lower levels.

The temperature and humidity change at different levels provides information on the amount of humidity sublimated when there is a temperature decrease.

Comparison of the temperature and humidity change can give a rough estimate of the occurrence of advection, evaporation and condensation at different levels. The correlation between 10-minute changes in absolute humidity and temperature at 0.1 m, 0.4 m, 1 m and 2.5 m for three occasions when hoar-frost developed on the road surface is shown in Figure 5. The measurements at 0.1 and 0.4 m show a good correlation

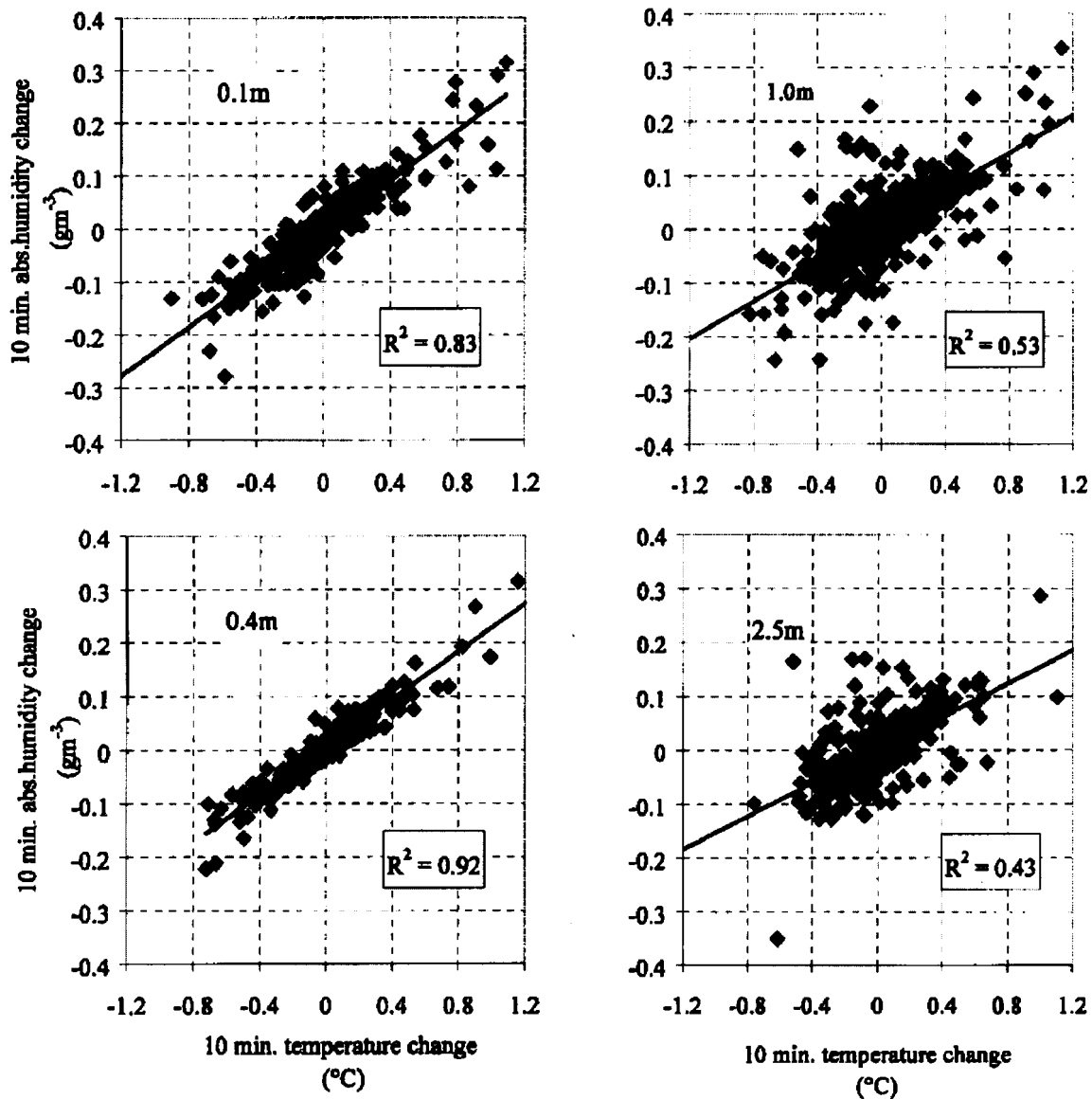


Figure 5. The 10 minute absolute humidity change plotted against temperature change for 0.1 m, 0.4 m, 1.0 m and 2.5 m from five occasions when hoar-frost sublimates on the road surface.

between the temperature and humidity changes whereas the correlations at 1.0 and 2.5 m are poorer. A decrease in air temperature without any exchange with other air masses results in a humidity increase since the volume of the air mass is reduced when the air temperature is lowered. However, at the lower levels a temperature decrease is associated with a humidity decrease, i.e. moisture is deposited at the road surface as hoar-frost. The pattern is more scattered at higher levels indicating that temperature and humidity changes are not closely associated with the processes at the road surface. An increase or decrease in temperature is also associated with a larger increase/decrease in humidity at lower levels. A temperature decrease of 0.4°C at the 0.1 m level corresponds to a humidity decrease of 0.1 g m^{-3} compared with a decrease of 0.06 g m^{-3} at 2.5 m, i.e. the amount of humidity that sublimates is higher at lower levels. The trend for 0.1 m and 0.4 m is very similar. Measurements from these

levels or the differences between the original equipment and these levels can be used to increase the accuracy of hoar-frost predictions.

3.5. Multiple regression based on RWIS data and temperature profiles

A forward multiple regression was performed on the data set to determine if the additional data measured in a profile above the road could increase the chance of an accurate hoar-frost prediction. The amount of data is small, but only the significant results (where $p < 0.0005$) are presented. The input data to the regression were retrieved from an RWIS station: wind speed, temperature difference between T_a and T_r , temperature difference between T_d and T_r , time with $T_r < T_d$, minimum T_r , minimum T_a and temperature fall. Among these, maximum temperature difference between T_a and T_r ,

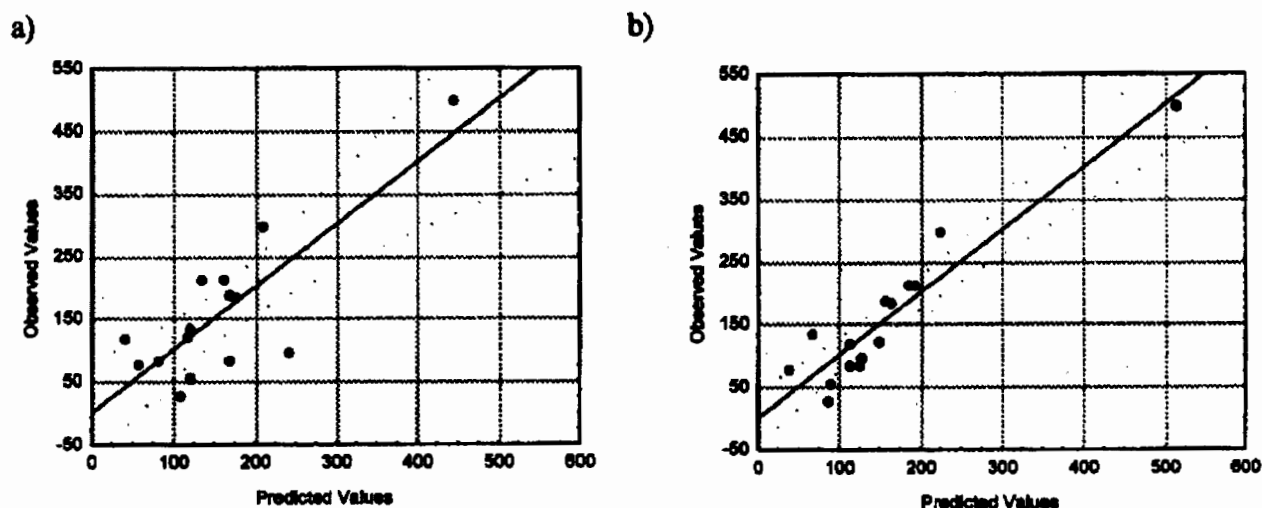


Figure 6. Observed versus predicted values of hoar-frost from a forward multiple regression performed with data from (a) RWIS and (b) RWIS and temperature profiles. The dotted line indicates the 95% confidence interval.

time with $T_r < T_d$, maximum difference between T_d and T_r and minimum T_d were chosen to explain the variation in amount of hoar-frost deposited. Together they produced a correlation coefficient of 0.82. When data from measuring profiles were included the correlation coefficient increased to 0.93. The following factors were chosen to explain the variation in amount of deposited hoar-frost: maximum temperature difference between T_d and T_r , time with $T_r < T_d$, maximum difference between T_r and T_d , maximum temperature gradient above the road, time with a strong inversion above the road and wind speed. In Figure 6 the predicted amount of hoar-frost compared with the observed amount is shown for the two multiple regressions. Data that can be retrieved from an RWIS are used in Figure 6(a). Both RWIS and data from measuring profiles are used in Figure 6(b). The results show that the correlation coefficient is high between the observed and predicted amount of hoar-frost, with data from the RWIS station used as input. However the chance of predicting hoar-frost increases when additional measurements at lower levels are added to the input data.

4. Conclusions

The following conclusions can be made:

- The amount of hoar-frost deposited on the road surface increased with increasing average wind speed, maximum difference between dew point (T_d) and road surface temperature (T_r), the air minimum temperature and the duration when $T_r < T_d$ which has been shown in other studies.
- The difference between $T_d - T_r$ failed to indicate hoar-frost on several occasions due to the location and poor accuracy of the measuring equipment.
- Measurements of temperature and humidity in a profile up to 2.5 m above the road surface showed that the air layer up to 0.4 m reflected the condi-

tions at the road surface, whereas the surrounding areas influenced the measurements at higher levels.

- A forward multiple regression performed on the data showed that measurements of temperature and humidity at lower levels increased the ability to detect deposition of hoar-frost on the road surface.
- Measurements of friction on the road surface, on occasions with hoar-frost, showed that the friction decreased with increasing difference between dew point and road surface temperature and increasing duration with $T_r < T_d$. There was no correlation between amount of hoar-frost and friction at the road surface. The friction is probably not only influenced by the amount of hoar-frost but also the structure of the hoar-frost, which has not been determined in this study.
- The ability to estimate amount of hoar-frost with the help of measured weather parameters will increase if measurements are performed at lower levels.

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