History can repeat (A tale of artificial noses)

It's August 2023. I'm driving on a sun-striped country road, listening intently to a book about the history of humanism by the UK writer Sarah Bakewell. Pink galahs and turquoise parrots strut jauntily along the verge in the shade of eucalypts, preoccupied with seeds. A startle in the wrong direction could end very badly; it happens all the time. Wrecked mounds of feathers are dotted here and there, memento mori. I concentrate on staying in the centre of my lane and alert for signs of flight. Still, I'm finding it a little hard to juggle my focus on the birds and the book as I drive. I get distracted, miss a few passages, and have to rewind. Despite these lapses in attention, I'm forcefully struck by the book's thesis that there is a recurring pendulum swing between what Bakewell characterises as humanist and anti-humanist drives in history. For Bakewell, humanism historically includes all kinds of thinking that place a high value on human life and flourishing. Anti-humanist thought encompasses ideologies that dismiss and devalue human life and elevate other values—such as unquestioning adherence to a leader—over human autonomy, privacy and other human rights.

The late afternoon light is getting fainter. As it does, my vigilance grows. I feel the tension in my body ratchet up as my peripheral vision scans the roadside for the wrens or kangaroos that might dart across the lanes as dusk falls. After hours of listening, the book, *Humanly Possible,* has reached its final chapter, 'The Place to be Happy'. In these pages, Bakewell writes about Jewish Ukrainian writer Vasily Grossman and his novel *Life and Fate,* written in the 1950s, when Stalin was in power. Grossman likens the death of a human being to the disappearance from the night sky of all the stars and all the galaxies of the Milky Way; to the loss of all colours, light and fragrance from the world; and to the loss of all sustenance, water and bread. Bakewell is struck by the juxtaposition in *Life and Fate* of this vision of such immense losses—each loss infinite, but unfathomably multiplied by the 'tens of millions' murdered in the service of fascism—with Grossman's speculation, elsewhere in the book, that human beings might one day give machines the ability to experience life as we do.

That evening, comfortably seated by a wood fire, I watch films from the Melbourne International Film Festival. In *Ukraine Guernica*, George Gittoes and Hellen Rose document the first invasion of Kiev and the state of the town of Irpin. The camera is a silent witness to the blasted homes: damaged photos of babies and children fluttering in the waste; dirty soft toys in the rubble; the interior of kitchens exposed by the collapse of an apartment building wall; the burned and twisted bodies of people who did not escape in time. Wrecked and blackened cars mark the places where babies, children, adults and the elderly perished on what became The

Bridge of Death. They tried to flee Irpin when the Russians arrived. They were massacred instead. This is what it looks like when the pendulum swings.

Nine months later, I'm sitting in the yard of the same country cottage as the sun goes down, reading a book and watching corellas as they fly wing to wing across the sky. Autumn colours are spreading through the dry grasses and the European trees scattered among the eucalypts. I keep putting down the book, my mind shuttling between the quiet solitude of dusk and the intimate stories of a distant, violent world.

The book is *Stasiland* by Anna Funder. It's a history of the Stasi, the East German secret police, which operated from 1950 to 1980, but whose political influence continued well beyond its formal end. In its opening pages, Funder recalls the 'smell samples' she found in a history museum dedicated to the Stasi. The Stasi trained sniffer dogs using intimate apparel, socks, and other items that might carry mere traces of a human odour, such as a cloth wiped over a just vacated seat. The samples were collected in jars and labelled with the name of a suspect or a dissident and the time and date of collection. Scents are subtle signals—a few signature molecules mixed with the rest of the air's natural elements, or those of a surface. Our skin, and other parts of our body, carry these molecules, known as 'volatile organic compounds'. 'Volatile' here means that these are chemicals that evaporate and fly. Smells are available for molecular detection, whether from surfaces or wafting on the air.

It feels very queer to be looking out across these peaceful fields while imagining the world of those agents, furtively following their eager dogs into parks and apartments in the hope that subtle odours will reveal the past presence of the hunted: men who sat together on a bench; a woman who drank slowly from a glass while murmuring to companions and left a trace of her lips like a smile on its rim; a girl who gripped the edge of a table, her cold and sweaty palms setting down their chemical moisture like a calling card: but none of them suspecting that the traces of their bodies might be read like a label.

Human scent jars wouldn't feel out of place in a Roald Dahl book, or a play by the 20th century anti-fascist playwright Eugène Ionesco, or a story by the 19th century Russian satirist, Nikolai Gogol, whose tale of a Nose that removes itself from a face and strikes out on its own is a classic satire that feels oddly resonant in a time of AI. And yet, here they were, both real and historic, part of a toolkit of vicious repression.

I pause to go inside and light a fire in the wood heater. I find myself wondering if anyone has applied artificial intelligence models in the way the Stasi did, to identify the traces of unique human beings from their body odours. Technologies with the potential to recognise smells have been around since the early 1980s.[1] Scent detection and recognition is one of the many lines of AI research that explicitly model human brain processes. Some of the AI scent detection technologies even use a new type of chip, called 'neuromorphic' for the way that it mimics how the brain selects the most important information from the noise of perception.

Medical research, too, has an interest in human smells. Diseases such as cancer have identifiable scent signatures in human patients. Soon doctors may use AI-based cancer scent detection in the suite of diagnostics. But it may not be very hard to extrapolate this process to identify the patient in addition to their illness.

My laptop on my knees and my feet by the fire, I enter 'human identity recognition from scent AI' in the search bar. Identifying people by their unique smell is, I discover, one branch of the burgeoning field of biometric inquiry.[2] Scent detection analysis relies on picking up specific chemical molecules, known as the 'primary odour' because of their persistence through environmental changes. These technologies are not as easily fooled as we humans can be—though sniffer dogs are not—by scents that 'mask' or conceal our body odour. The levels of accuracy purportedly attained by this research are striking. A 2018 machine learning study by two Chinese researchers found that eighty-five percent of people in the sample could be identified by their body odour.[3] As early as 2013, the same level of accuracy was obtained by machine learning researchers in Spain using novel sensors to capture the scent of hands.[4] The Spanish researchers note in their introduction that the idea isn't new, only the execution, bloodhounds having been trained to help police track suspects for more than a century. They explain that current fingerprint and iris scan techniques used in airports are highly accurate, but people may be reluctant to offer their biometric data. Not to worry. Advances in technology, they suggest, may circumvent resistance, with the development of discreet sensors to capture body odour and 'non-invasive' biometric techniques being developed to use with those sensors. 'Non-invasive' is a coy way of saying that a person's active consent isn't needed to take their scent sample. Or, by extension, to predict who they are from their signature scent.

I discover that the sources of unique human odours include various skin surfaces (hands and feet, scalp, neck and face), breath and urine, with factors affecting the chemical composition of the odour including age, gender, diet, physical conditions of the body, climate, genetics and living habits.[5] A 2017 paper by US researchers found that two of these variables, gender and race, could be quite accurately classified on the basis of volatile compounds from their subjects'

hands.[6] The gender of eighty percent of participants was correctly recognised. Caucasian subjects were accurately classified seventy-two percent of the time. For East Asians, it was eighty-two percent, and Hispanics, sixty-seven percent. The researchers were pleased with these findings, noting that individual classification appeared to be a viable prospect.

In 2022, Japanese researchers, noting the low concentration of the primary odour provided by human skin, developed an 'artificial nose' that can smell human breath. This might be a better way, they thought, to recognise human beings through their volatile compounds. Indeed, their pilot study correctly recognised more than ninety-seven percent of a sample of twenty people.[7]

The references go on. But one angle catches my attention. An Indian and Norwegian research team tested public acceptance for body odour biometrics. The authors note that combining biometric technologies, such as voice and facial recognition, can improve 'safety or reliability'. They observe that 'another non-invasive biometric technique' gaining attention is body odour and—leaving the reader in no doubt about their opinion—they affirm that identifying individuals from their odour is a 'crucial task.'[8]

One hundred and fifty people were surveyed to understand how acceptable odour-based technology might be to the public, since even a sophisticated and advanced technology may be rejected if considered unacceptable. Indeed, most of their subjects expressed either fear, discomfort or reluctance. (None, I imagine, were former East Germans.) Technology consumers, the authors observe, might worry that the body odour data used for authentication could also reveal information about their health. Diseases such as diabetes, cancer, carcinoma, hormonal imbalances, liver diseases and metabolic disorders could, they suggest, be inadvertently disclosed. Nevertheless, this understandable reluctance on the part of their subjects is framed as a risk to desirable applications with a strong 'market position'. The study, it turns out, is an exercise in *know your enemy*. The authors turn to the reasons that body odour detectors ought to be developed, referring to a 2015 study that argued for more biometrics to support the work of law enforcement agencies, aiding public protection, and helping to guarantee the national defence.[9] In a similar vein, a 2014 paper by Indian researchers makes the case for body odour detection in addition to iris scans and fingerprints for identity checks.[10]

Here I feel the need to pause. Perhaps you feel the same. This theme is a common one in biometric studies: the collection and analysis of intimate human data will ensure the 'security' of the public and the 'safety' of our nation states. Data on people's bodily fluids, in this case, must be utilised for our 'protection'. Our homeostatic system, which monitors our body's internal and external environments for threats and rewards, is poked into vigilance by words such as these:

protection, security, defence. Reading them now, I feel a subtle tightening in my chest. Each of these words brings its opposite with it: *vulnerability, insecurity, attack*. It's these shadow meanings and their urgency that our bodies respond to in a visceral way. Most of the time we're unaware of that response. But if it happens often enough, it becomes the way that we respond to the world. An undesirable habit of vigilance.

The commercial imperative is often explicit and mentioned in the same breath as the supposed concerns these technologies will address. The authors of the 2015 study nod to several extant orders for body odour systems. Receiving organisations include the British Embassy in Buenos Aires, Saudi Arabia's National Guard, and privately owned Indian and Japanese companies.

I stare into the fire, which is burning low by now. Stress produces chemical changes that can be detected in body odour, as does sexual activity and medications. Even emotions such as terror, anger, disgust and happiness appear to have identifiable chemical signatures that can be retrieved from body odour.[11] What regime would not delight in smelling out its dissidents? And yet, unless our regulations prevent it, AI odour detection by artificial noses could become a routine component of surveillance systems: a sinister cousin to Gogol's enterprising Nose. Their 'contactless' nature is a selling point. Our active participation isn't required, as it is for iris scans or fingerprints. No, the researchers assure us, the average person—referred to as a 'novice'—will never suspect she is being monitored. She need never know that her scent is being sampled, her identity matched, and—for it is sure to happen once technology enables it—her state of health assessed without consent.

I wake next morning to continue my research. The day is warm and bright. A light wind blows through the fruit trees in the yard of the cottage. The blue-painted bench where I sat last evening is inviting and I want to return to the yard. I feel safe and at home in my skin and in the world. The sight alone of the sunlit lawn suffuses my body with a quiet sense of joy. But there is work to do.

I want to understand better how homeostatic feelings—those delicate, internal sensations of threat or wellbeing—are triggered by words or events. I open a book by an American cognitive neuroscientist, David Ritchie. In *Feeling, Thinking, and Talking: How the Embodied Brain Shapes Everyday Communication*, Ritchie observes that activating the survival circuits initiates a flood of chemicals and reactions in our bodies and our brains.[12] It's this flood that made me sense an anxious tightening in my chest as I read the words 'security' and 'protection'. The same flood of chemicals made me feel tense and vigilant as I drove along the road as dusk fell, knowing there

was a growing chance of kangaroos or birds crossing my path. Survival circuits, Ritchie explains, enhance our attention to the world, helping us to access information and behaviours that can overcome a threat.

The fact of surveillance—never knowing when or how you are observed—can feel like a threat and may lead to a state of vigilant arousal. This arousal impacts your ability to process information, since processing bandwidth is tied up with monitoring the outside world for sudden threats. That's why instilling a neuro-chemical habit of vigilance can be a powerful tool for controlling populations. Researchers have described what happened in communist states such as East Germany, where anxiety, provoked by recurrent purges and the fear of being reported, resulted in a constant state of suspicion. Ethnographer Sven Daniel Wolfe observes the 'tensions, fleeting interactions, and situatedness that constitute the intimate' in a totalitarian regime, recording a frightening 'series of encounters with state authority figures that occur in quotidian moments: arriving at an airport, checking into a hotel, going for a hike'. 'Illiberal practices,' Wolfe elaborates, 'are those that violate individual rights, autonomy, and dignity, in both political and quotidian senses.'[13]

I find myself imagining a world where commercial sensors might target my body's scent in public places, such as airports, to find out who I am, and further, the most intimate details of my health and state of mind. Depending on the nature of the authority behind the odour sensors—democratic or autocratic—they might also record my levels of stress and other kinds of arousal, and if I am a woman, my menstrual status, without my awareness or consent. It's not hard to imagine the illiberal uses of information such as this.

It seems the bleak history of intimate human surveillance by scent has been entirely forgotten. We ask ourselves *how history repeats, why we didn't see it coming*. With human odour recognition, we can clearly see it coming. Humanism, as Bakewell describes it, has a role to play in uncovering technologies such as this, that will strip away our dignity, autonomy, and right to privacy, and turn us into recognition targets for an artificial nose.

I get up and go for a walk in the garden. A red-breasted robin is hopping around the woodpile in the sun. Our eyes meet for a moment before it flies away. I feel my body moving in the open air: free, at peace, and unobserved.

Endnotes

1. See for example, K. Persaud & G. Dodd, 'Analysis of discrimination mechanisms in the mammalian olfactory system using a model nose', *Nature*, 1982, 299, pp. 352–5.

2. For an overview of research using pre-AI methods, see R. Peters et al., 'Human scent characterization: A review', *Forensic Science International*, 2023, 349.
3. B. Yang & W. Lee, 'Human body odor-based authentication using machine learning', *Proceedings of the 2018 IEEE Symposium Series on Computational Intelligence,* Bengaluru, India, 18–21 November 2018, pp. 1707–1714.
4. I. Rodriguez-Lujan, et al., 'Analysis of pattern recognition and dimensionality reduction techniques for odor biometrics', *Knowledge-Based Systems,* 2013, 52, pp. 279–289.
5. The categories mentioned are from Figure 1 in S. Naaz et al., 'OdorTAM: Technology Acceptance Model for biometric authentication system using human body odor', *International Journal of Environmental Research and Public Health*, 2022, 19, p.3.
6. Colón-Crespo, L.J. et al., 'Determination of VOC marker combinations for the classification of individuals by gender and race/ethnicity', *Forensic Science International*, 270, 2017, pp. 193-9.
7. Kyushu University, 'Sniffing out your identity with breath biometrics', *ScienceDaily*, <www.sciencedaily.com/releases/2022/06/220622101308.htm>, 22 June 2022, accessed 19 June 2024.
8. S. Naaz et al., 'OdorTAM: Technology Acceptance Model for biometric authentication system using human body odor', *International Journal of Environmental Research and Public Health*, 2022, 19.
9. T. Kazimov & S. Mahmudova, 'The role of biometric technology in information security', *International Research Journal of Engineering and Technology*, 2015, 2, pp. 1509–13.
10. P. Inbavalli & G. Nandhini, 'Body odor as a biometric authentication', *International Journal of Computer Science and Information Technologies*, 5, 2014, pp. 6270-4.
11. References to the effects of stress and emotion on body odour abound; these are a selected few: G.-B. Wintermann et al., 'Altered olfactory processing of stress-related body odors and artificial odors in patients with panic disorder', *PLoS ONE,* 2013, 8; M.A.M. Smeets et al., 'Chemical fingerprints of emotional body odor.' *Metabolites,* 2020, 10; E. Calvi et al., 'The scent of emotions: A systematic review of human intra- and interspecific chemical communication of emotions', *Brain and Behaviour,* 2020, 10; J.H. de Groot, P.A. Kirk & J.A. Gottfried, 'Encoding fear intensity in human sweat.' *Philosophical Transactions of the Royal Society of London, Series B,* 2020, 375.
12. D. L. Ritchie, *Feeling, Thinking, and Talking: How the Embodied Brain Shapes Everyday Communication.* Cambridge University Press, 2022.
13. S. Wolfe, 'Between the Minor and the Intimate: Encountering the Authoritarian (Extra)ordinary in Russia, Belarus, and Ukraine.' *Geopolitics*, 2021, 28, pp. 1-26.