

Bijlage VWO
2017

tijdvak 2

Engels

Tekstboekje

Tekst 1

Excellent news arrives from the BBC. Corporation executives have decided to rip out all the carpets in the £1bn New Broadcasting House because they are not sufficiently "inspiring". Quite right. I find it impossible to think creatively if I am surrounded by bland and unchallenging floor coverings. Woodstrip, in particular, leaves me in a state of catatonic despair.

What the BBC needs is far more 1, yet inclusive, carpeting. That might stop it commissioning such turgid, predictable dross as David Hare's *Turks & Caicos*. Only a man surrounded by grey acrylic/wool carpet tiles, could possibly have sanctioned that steaming pile of ordure. Onwards and upwards.

adapted from *The Sunday Times*, 2014

EVOLUTION

Scrappy Pets

- 1 **Scientists** have two theories for how dogs became man's best friend. One holds that people captured wolf pups and tamed them for their hunting and guarding abilities. The other, more popular explanation proposes that the advent of agriculture and the attendant development of human settlements in the Middle East around 10,000 years ago created scavenging opportunities for animals bold enough to exploit them and that wolves themselves thus initiated domestication.



New findings, published online January 23 in *Nature*, support this latter view and offer insights into how canine ancestors were able to take advantage of this novel resource.

- 2 Erik Axelsson of Uppsala University in Sweden and his colleagues analyzed DNA from 12 wolves and 60 dogs that represent 14 diverse breeds, looking for regions of the dog genome that evolved under selection pressure during domestication. Intriguingly, genes involved in the metabolism of starch showed up among the targets, along with genes that may have brought about behavioral changes such as reduced aggression and improved social-cognitive skills. In fact, the study revealed that during the domestication of dogs, selection acted on genes involved in all three stages of starch digestion, promoting mutations that facilitated the transition from a meat-centric diet to one heavy on starch.
- 3 Previous studies have shown that cats, too, may have domesticated themselves by dining on human leftovers. Although house cats have only a limited ability to metabolize carbohydrates, including starch, they possess a longer intestine than their wild counterparts, presumably to help digest the lower-quality sustenance they get from trash heaps compared with the all-meat diet they would be living on in the wild, according to geneticist Carlos Driscoll of the National Institutes of Health. In other words, begging for table scraps has been a long dog and cat tradition.

—Kate Wong

adapted from *ScientificAmerican.com*, 2013

The case for the cyberdefence

Governments and companies must co-operate more closely

- 1 The march of cyberwar from science fiction to fact continues apace. On Wednesday, Google revealed that, for the second time in two years, it had fallen victim to a cyberattack launched in China. The latest assault targeted users of its Gmail service — including senior US officials — who were sent customised bogus e-mails that tricked them into giving away the passwords to their e-mail accounts.
- 2 "Spear-phishing", as this practice is known, is already common: British government departments are the target of 1,000 attacks per month. As the world's reliance on computer networks grows, such threats will only become more acute. It is crucial, therefore, that governments and companies take steps now to combat this problem.
- 3 Despite moves this week by the US government to classify cyber-attacks as an act of war (which might allow military retaliation), cold-war-style deterrence is not a realistic option. As the uncertainty over the identity of Google's attackers shows, cyberweapons can be used with a degree of anonymity. Threats of reprisals (and international treaties) are therefore no more than empty words.
- 4 That puts a premium on defence. Here there is much that governments and companies can do, both individually and in concert. Companies should isolate sensitive systems from both the internet and other internal networks. They must also control gadgets used by staff more tightly (Stuxnet, after all, spread through flash-drives). Such steps will be easier to co-ordinate if the role of the chief technology officer is boosted.
- 5 Other changes will require a radical shift in corporate culture. One of the difficulties in fighting cybercrime is that companies rarely share information on security breaches. That allows attackers to perform the same trick on many targets. To combat this, companies must get used to pooling details of security breaches with their rivals. Anonymising the information might make this process easier.
- 6 For their part, governments must include the private sector in their defensive planning. An attack on the banking sector, for example, could be crippling. Yet most cyberdefence agencies focus on protecting government and the military. That must change. Governments should also enforce higher security standards for software products.
- 7 Ultimately, however, systems are no securer than the staff who run them. The latest attack on Google exploited not technical but human frailty. That is something no amount of technology can cover.

Financial Times, 2011

The bacteria wars

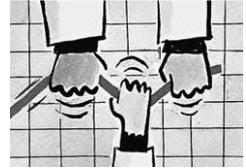
- 1 **J**ust 65 years ago, David Livermore's paternal grandmother died following an operation to remove her appendix. It was not the surgery that killed her. She succumbed to a series of infections that the pre-penicillin world had no drugs to treat. Welcome to the future.
- 2 The era of antibiotics is coming to a close. In just a couple of generations, what once appeared to be miracle medicines have been beaten into ineffectiveness by the bacteria they were designed to knock out. The post-antibiotic apocalypse is within sight. Hyperbole? Unfortunately not. The highly serious journal *The Lancet* last week posed the question in the title of a paper revealing the rapid spread of multi-drug-resistant bacteria. "Is this the end of antibiotics?" it asked. The paper by Professor Tim Walsh and colleagues takes the anxiety to a new level.
- 3 Last September, Walsh published details of a gene he had discovered, called NDM-1, which passes easily between types of bacteria such as *E coli* and *Klebsiella pneumoniae* and makes them resistant to almost all of the powerful, last-line group of antibiotics called carbapenems. Last week's paper revealed that NDM-1 is widespread in India and has arrived in the UK. "In many ways, this is it," Walsh tells me. "This is potentially the end. There are no antibiotics in the pipeline that have activity against NDM-1 producing enterobacteriaceae. We have a bleak window of maybe 10 years, where we are going to have to use the antibiotics we have very wisely, but also grapple with the reality that we have nothing to treat these infections with."
- 4 And this is the optimistic view — based on the assumption that drug companies can and will get moving on discovering new antibiotics to throw at the bacterial enemy. Since the 1990s, when pharma found itself twisting and turning down blind alleys, it has not shown enthusiasm for difficult antibiotic research. And because, unlike with heart medicines, people take the drugs for a week rather than life, and since resistance means the drugs become useless after a while, there is just not much money in it.
- 5 Dr Livermore, whose grandmother died for lack of infection-killing drugs, is director of the antibiotic resistance monitoring and reference laboratory of the UK Health Protection Agency. He is far from sanguine about the future. "A lot of modern medicine would become impossible if we lost our ability to treat infections," he says. 9, but "we are certainly scraping the bottom of the barrel to find effective antibiotics".
- 6 For a long time now, doctors have known they were in a race to stay a few steps ahead of the rapidly growing resistance of bacterial infections to antibiotics. Hygiene is an obvious weapon. Better cleaning, hand gels and stern warnings to staff and public alike have helped reduce infection rates in British hospitals. But Professor Richard James, director of the centre for healthcare-associated infections at the University of Nottingham, warns that bugs don't stay in hospitals.

- 7 "The worry is once these organisms are out in the community," says James. "There probably is some need for public education about infection and, for instance, kitchen hygiene when you are cooking. People of my generation were taught a lot about washing your hands before every meal. It was automatic that it was done. A lot of that 10." There are some innovative ideas about, he says, on ways of teaching children in school to wash their hands — in the hope that they will then go home and pester their parents to do the same.
- 8 Beyond that, there is a real need to conserve those antibiotics we have. There have now been a couple of interesting papers suggesting tax — which James defines as one levied on an agent causing an environmental problem as an incentive to mitigate that problem — for antibiotics. Antibiotic usefulness is finite. And the cost of drug resistance is not reflected in the price of the drug. "If you consider antibiotic sensitivity as a resource like oil, you want to maintain that by introducing a tax," he says. It would be worldwide and the proceeds could fund new drug development.
- 9 But should you tax life-saving drugs, especially in poor countries? "If you don't do anything, there won't be any antibiotics anyway," says James. "It is a suggestion of something that could be done."
- 10 "Frankly, pharmaceutical companies as well as governments and the European commission need to really get their act together," says Walsh, who has been urging co-ordinated efforts across the world to put in place good surveillance systems to find out what resistance is developing and where, and then look for interventions.
- 11 In the battle for survival of the fittest between human beings and bacteria, just now it looks as though the best we are going to get is a draw, if we are lucky.

adapted from *The Guardian Weekly*, 2010

Climate change

A heated debate



- 1 **"W**HAT is truth?" That was Pontius Pilate's answer to Jesus's assertion that "Everyone that is of the truth heareth my voice." It sounds suspiciously like the modern argument over climate change.
- 2 A majority of the world's climate scientists have convinced themselves, and also a lot of laymen, some of whom have political power, that the Earth's climate is changing. They feel that the change, from humanity's point of view, is for the worse; and that the cause is human activity, in the form of excessive emissions of greenhouse gases such as carbon dioxide. A minority, though, are sceptical. They think that recent, well-grounded data suggesting the Earth's average temperature is rising are explained by natural variations in solar radiation, and that this trend may be coming to an end. Some argue that longer-term evidence that modern temperatures are higher than they have been for hundreds or thousands of years is actually too flaky to be meaningful.
- 3 Such disagreements are commonplace in science. They are eventually settled by the collection of more data and the invention of more refined (or entirely new) theories. Arguments may persist for decades; academics may — and often do — sling insults at each other; but it does not matter a great deal because the stakes are normally rather low.
- 4 14, the stakes in the global-warming debate could scarcely be higher. Scientific evidence that climate change is under way, is man-made, and is likely to continue happening, forms the foundation for an edifice of policy which is intended to transform the world's carbon-intensive economy into one which no longer spews greenhouse gases into the atmosphere. A lot of money, and many reputations — both academic and political — are involved.
- 5 Sceptics claim that this burden of responsibility is crushing the spirit of scientific inquiry. Scientists, they maintain, are under pressure to bolster the majority view. The recent publication of embarrassing e-mails from the University of East Anglia, an important centre of climate science, revealing doubts about data and a determination not to air such concerns publicly, has strengthened these suspicions.
- 6 It is clear that politics and science make uncomfortable bedfellows. 16. The creation of the Intergovernmental Panel on Climate Change to establish a consensus on the science was an excellent idea for policymakers, who needed a strong scientific foundation for their deliberations, but it sits uncomfortably with a discipline that advances by disproving accepted theories and overturning orthodoxies.
- 7 Some would argue that, in matters of great public import, scientific dissent should be silenced. It can, it is true, do harm. When AIDS first

reared its ugly head, no one knew what caused it. Gradually, the virus responsible was isolated, identified and then attacked successfully with drugs designed specifically to inhibit its reproduction. A few scientists, though, refused to accept the evidence, and some politicians used their arguments to justify inaction. Since one of those politicians was Thabo Mbeki, then president of South Africa, hundreds of thousands who might have been saved by an anti-AIDS policy grounded in scientific reality died as a result of his policies.

8 Yet the damage in that case was done by the politicians. A leader who is determined to pursue a wrong-headed course will always find some scientist to support him. A world in which that were not true would be one in which a dangerously narrow consensus had taken hold.

9 This newspaper believes that global warming is a serious threat, and that the world needs to take steps to try to avert it. That is the job of the politicians. But we do not believe that climate change is a certainty. There are no certainties in science. Prevailing theories must be constantly tested against evidence, and refined, and more evidence collected, and the theories tested again. That is the job of the scientists. When they stop questioning orthodoxy, mankind will have given up the search for truth.

adapted from *The Economist*, 2009

FRANCIS GILBERT

School report

THE LEARNING GAME: A TEACHER'S INSPIRATIONAL STORY

Jonathan Smith *Little, Brown, 252pp, £14.99*

BAD BOYS, BAD MEN: CONFRONTING ANTISOCIAL PERSONALITY DISORDER

Donald W Black and C Lindon Larson *OUP, 256pp, £9.50*

- 1 **H**aving taught for a number of years, I can easily spot the time-servers in the staffroom. There are two types: the contented and the seriously disgruntled. Usually you find a good number of discontented teachers who, through their own inertia or incompetence, have become "stuck" in inner-city state schools, but they exist in the leafy suburbs, too. They conform to certain stereotypes that we have of teachers. Their clothes have acquired the same texture as the furniture, and they constantly remind their younger colleagues that they should leave the profession as soon as they can.
- 2 The contented time-server is an altogether different and much rarer species. Often they are morally upstanding and have a genuine vocation for teaching. If they work in a school where discipline is lax, they often have a reputation for being tough; if they teach in an easier institution, they love hearing the sound of their own voice.
- 3 Jonathan Smith falls into the latter category. For more than 30 years, he taught English at Tonbridge, a public school for boys in Kent. Why he or his publishers felt that he had anything of import to say about teaching was not immediately obvious. 20, his experience of teaching is extremely limited, given that most of his career was spent lecturing to largely receptive, selected boys about his favourite writers — Wordsworth, Frost, Conrad and Larkin. Despite having such tractable pupils, Smith shows a shocking reluctance to experiment. Some of the most important research into the relationship between speaking and literacy is dismissed in a sentence: "What to some teachers is the happy buzz of teamwork to me feels too out of control, a cheerful anarchy." Even a traditionalist such as Chris Woodhead wouldn't speak about group work in these terms.
- 4 The truth, it seems, is that Smith enjoyed talking *at classes* throughout his career. Every piece of advice and anecdote in this dismal book is predicated around this notion. True, he seems to favour class discussions, but only when the teacher is guiding everything. As a consequence, much of Smith's account is about how he established the right conditions in which to hold forth. He talks about having "the Look" — a quasi-mystical glance that quietens unruly boys — and he offers a few "simple dodges" that assist with teaching.

- 5 But, like many contented time-servers, Smith is not courageous and, in his writing, has slipped into some lazy habits. There are missed opportunities in this uneasy hybrid: part teaching autobiography, part "common sense" handbook for teachers.
- 6 If Smith had been a little braver, he could have stretched its parameters further. For example, he trumpets proudly that he taught the novelist Vikram Seth, the poet Christopher Reid and the poet-publisher Vikram Jayanti. Why didn't he talk to them about what they thought of their schooldays and his teaching? It would certainly have been interesting to read about their experiences.
- 7 Ultimately, it becomes clear that even though Smith has a novelist's eye for mischief — he has written five novels and a television play — he is, like all self-respecting time-servers, not willing to question the establishment that provided him with such a happy life. At no point is he critical of the elitism and snobbery that characterises these august institutions.
- 8 Should we be surprised that a major publisher has issued such a dull, self-congratulatory book? It sadly remains the case that, despite public schools forming a small percentage of British educational establishments, most people in positions of power — newspaper editors, politicians, barristers, civil servants, professors — went to public schools. And these people still think that "real" teaching only occurs in such places.
- 9 Although Smith poses as a teacher with experience of bad behaviour, I suspect that he doesn't know what truly unruly pupils are like. The kind of aggressive antics discussed in the case studies in *Bad Boys, Bad Men* are much more closely tied to the excesses I have observed in inner-city classrooms.
- 10 Donald Black, a professor of psychiatry at the University of Iowa, examines what he calls "antisocial personality disorder" (ASP), drawing on new evidence from genetics and neuroscience to support his argument. He describes ASP as being a "pattern of recurrent antisocial, delinquent or criminal behaviour that begins in early childhood or early adolescence and is manifested by disturbances in many areas of life: family relations, schooling, work, military service and marriage". He cites unconvincing evidence that ASP may be genetically transmitted. He is more persuasive when arguing that afflicted men may be suffering from a deficit of the neurotransmitter serotonin, the chemical in the brain that regulates aggression.
- 11 This set me thinking about the absence of any discussion on notions such as ASP in the book written by Smith, who teaches only the affluent sons of middle-class and upper-class parents. While we shouldn't ignore new developments in neuroscience and genetics, no amount of science can dissuade me from the belief that most of our problems with dysfunctional behaviour are rooted in the rigid class structures of western society. If you are born into a materially and socially privileged class, you generally stay in it; if you are born into an underclass, it is very hard to escape.

New Statesman, 1996

Tekst 7

The following text is the beginning of the first chapter of The Grass is Singing, by Doris Lessing.

The Grass is Singing takes place in South Africa during the 1940s and deals with apartheid, the racial segregation between blacks and whites.

MURDER MYSTERY **By Special Correspondent**

Mary Turner, wife of Richard Turner, a farmer at Ngesi, was found murdered on the front verandah of their homestead yesterday morning. The houseboy, who has been arrested, has confessed to the crime. No motive has been discovered.

It is thought he was in search of valuables.

- 1 The newspaper did not say much. People all over the country must have glanced at the paragraph with its sensational heading and felt a little spurt of anger mingled with what was almost satisfaction, as if some belief had been confirmed, as if something had happened which could only have been expected. When natives steal, murder or rape, that is the feeling white people have.
- 2 And then they turned the page to something else.
- 3 But the people in 'the district' who knew the Turners, either by sight, or from gossiping about them for so many years, did not turn the page so quickly. Many must have snipped out the paragraph, put it among old letters, or between the pages of a book, keeping it perhaps as an omen or a warning, glancing at the yellowing piece of paper with closed, secretive faces. For they did not discuss the murder; that was the most extraordinary thing about it. It was as if they had a sixth sense which told them everything there was to be known, although the three people in a position to explain the facts said nothing. The murder was simply not discussed. 'A bad business,' someone would remark; and the faces of the people round about would put on that reserved and guarded look. 'A very bad business,' came the reply — and that was the end of it. There was, it seemed, a tacit agreement that the Turner case should not be given undue publicity by gossip. Yet it was a farming district, where those isolated white families met only very occasionally, hungry for contact with their own kind, to talk and discuss and pull to pieces, all speaking at once, making the most of an hour or so's companionship before returning to their farms where they saw only their own faces and the faces of their black servants for weeks on end. Normally that murder would have been

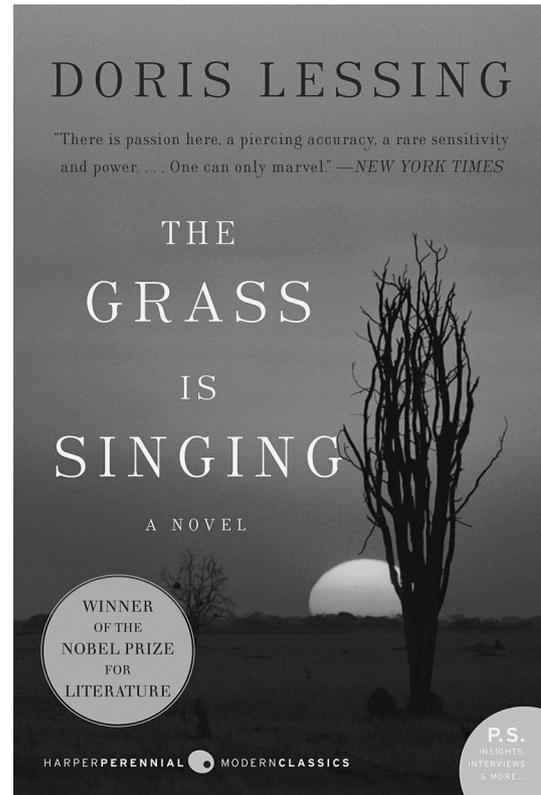
discussed for months; people would have been positively grateful for something to talk about.

4 To an outsider it would seem perhaps as if the energetic Charlie Slatter had travelled from farm to farm over the district telling people to keep quiet; but that was something that would have never have occurred to him. The steps he took (and he made not one mistake) were taken apparently instinctively and without conscious planning. The most interesting thing about the whole affair was this silent, unconscious agreement. Everyone behaved like a flock of birds who communicate – or so it seems – by means of a kind of telepathy.

5 Long before the murder marked them out, people spoke of the Turners in the hard, careless voices reserved for misfits, outlaws and the self-exiled. The Turners were disliked, though few of their neighbours had ever met them, or even seen them in the distance. Yet what was there to dislike? They simply 'kept themselves to themselves'; that was all. They were never seen at district dances, or fêtes, or gymkhanas. They must have had something to be ashamed of; that was the feeling. It was not right to seclude themselves like that; it was a slap in the face of everyone else; what had they got to be so stuck-up about? What, indeed! Living the way they did! That little box of a house – it was forgivable as a temporary dwelling, but not to live in permanently. Why, some natives (though not many, thank heavens) had houses as good; and it would give them a bad impression to see white people living in such a way.

6 And then it was that someone used the phrase 'poor whites'. It caused disquiet. There was no great money-cleavage in those days (that was before the era of the tobacco barons), but there was certainly a race division. The small community of Afrikaners had their own lives, and the Britishers ignored them. 'Poor whites' were Afrikaners, never British. But the person who said the Turners were poor whites stuck to it defiantly. What was the difference? What was a poor white? It was the way one lived, a question of standards. All the Turners needed were a drove of children to make them poor whites.

7 Though the arguments were unanswerable, people would still not think of them as poor whites. To do that would be 31. The Turners were British, after all.



Books and arts

The future of English

It used to be English

The Last Lingua Franca: English Until the Return of Babel.

By Nicholas Ostler

Walker & Company

1 ENGLISH is the most successful language in the history of the world. It is spoken on every continent, is learnt as a second language by schoolchildren, and is the vehicle of science, global business and popular culture. Many think it will spread without end. But Nicholas Ostler, a scholar of the rise and fall of languages, makes a surprising prediction in his latest book: the days of English as the world's lingua franca may be numbered.

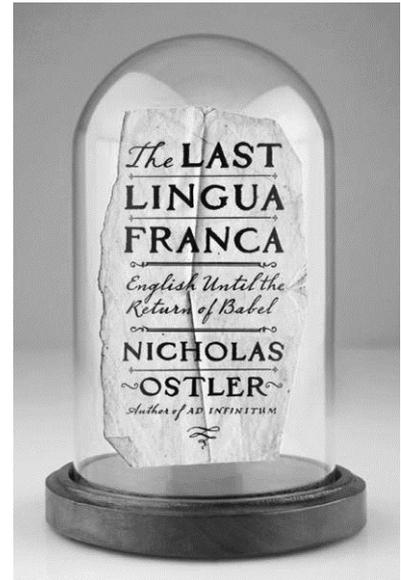
2 Conquest, trade and religion were the biggest forces behind the spread of earlier lingua francas. A linguist of astonishing voracity, Mr Ostler plunges happily into these tales from ancient history. It seems sometimes that

Mr Ostler, fascinated by ancient uses of language, wanted to write a different sort of book but was persuaded by his publisher to play up the English angle. The core arguments about the future of English come in two chapters at the end of the book. But the predictions are striking.

3 English is expanding as a lingua franca but not as a mother tongue. More than 1 billion people speak English worldwide but only about 330m of them as a first language, and this population is not spreading. The future of English is in the hands of countries outside the core Anglophone group. Will they always learn English?

4 Mr Ostler suggests that two new factors — **34** — will check the spread of English. No confident modern nation would today make a foreign language official. Several of Britain's ex-colonies once did so but only because English was a neutral language among competing native tongues. English has been rejected in other ex-colonies, such as Sri Lanka and Tanzania, where Anglophone elites gave way to Sinhala- and Swahili-speaking nationalists. In 1990 the Netherlands considered but rejected on nationalist grounds making English the sole language of university education.

5 English will fade as a lingua franca, Mr Ostler argues, but not because some other language will take its place. No pretender is pan-regional



enough, and only Africa's linguistic situation may be sufficiently fluid to have its future choices influenced by outsiders. Rather, English will have no successor because none will be needed. Technology, Mr Ostler believes, will fill the need.

- 6 This argument relies on huge advances in computer translation and speech recognition. Mr Ostler acknowledges that so far such software is a disappointment even after 50 years of intense research, and an explosion in the power of computers. But half a century, though aeons in computer time, is an instant in the sweep of language history. Mr Ostler is surely right about the nationalist limits to the spread of English as a mother-tongue. If he is right about the technology too, future generations will come to see English as something like calligraphy or Latin: prestigious and traditional, but increasingly dispensable.

adapted from *The Economist*, 2010

Women in politics

A very suitable job

- 1 The women thing is back. Last week the MP for Thanet, Laura Sandys, announced that she had decided not to stand in 2015, citing the demands of the job and the conflict with responsibilities in her personal life. The news that a talented backbencher for whom promotion was often forecast was giving up was the cue for a familiar narrative, much of it intended to be sympathetic but all of it contributing to one impression: politics is an unsuitable job for a woman.
- 2 So far, 36 MPs are standing down at the next election. Nine of them are women, which reflects almost exactly the percentage of women there are in parliament. The facts just don't support the widely held view that women can't stand the heat.
- 3 Perhaps there is a lesson for campaigners in the way the facts are so often distorted. Many of those who have worked so tirelessly to get fairer representation of women have emphasised the barriers to success. But there are other aspects of parliament that are as tough for men as they are for women. Take the way it works — the long and sometimes unpredictable hours, or the confrontational nature of the chamber of the Commons — which is often blamed for making life for women MPs particularly difficult. But many men would confirm that it's a rough job for anyone. New MPs come in expecting to work 60 hours a week and find it's 90. They imagine glamour, or at least purpose, and find constituents' drainage issues. They are among the most reviled and abused members of society.
- 4 Of course, there is still a lot to do. But it's time to celebrate the success of women in politics. There's plenty of it.

adapted from *The Guardian Weekly*, 2013

For an insight into the game, see your analyst

Owen Slot

1 **H**ow smart can you be during a game of rugby? Sir Clive Woodward is lauded for what has become recognised as one of the smartest changes during the 2003 World Cup quarter-final against Wales, when he brought on Mike Catt to relieve the pressure on Jonny Wilkinson.

2 In the modern game, a lot of the wisdom is being compiled on the laptops in the coaches' booths. In some sports — American football, for instance — coaches use live GPS data from their tracking systems to establish the form and workrate of their players, and often to make decisions on substitutions.

3 The England rugby team, however, do not use such real-time data during the game. "We don't look at GPS and heart rates; we haven't got time," Graham Rowntree, the forwards coach, said yesterday. England decide on how and when to use their replacements according to the coaches' experience and judgment rather than any statistical feedback.

4 On the coaches' monitors, they receive two feeds. One is real-time, the other has a 30-second delay, allowing an instant chance to review.

5 The smart work on the laptops is being done not by coaches but by the analysts working for them. England have two analysts working off two monitors, one of which is the standard BBC feed, with John Inverdale and all his chums. The other is the "wide shot" continuous feed that allows the analysts access to the live game pictures when the BBC coverage chops away for a replay.

6 The job of the analysts is to 40. If Rowntree wants to review a particular scrum, he will therefore have immediate access to it. At half-time, also, Rowntree can have access to a group of scrum clips or lineout clips to show to his players.



The Times, 2014



Run on tiptoe

HUMANS living millions of years ago were runners, but how did they do it without air-cushioned soles?

Daniel Lieberman at Harvard University and colleagues compared the gait of a in the US and Kenya and found that more than two-thirds of those who grew up running barefoot or had trained themselves to do so as adults ran on their tiptoes, landing on the balls of the feet first. The trend is unusual: 80 per cent of b land heel-first.

The result suggests that our ancestors were c. This may simply reduce pain. In racetrack tests, the team showed that the impact on the foot is seven times as great in d. "It's like someone hitting you on the heel with a hammer three times your body weight," says Lieberman.

This is because the collision force depends on how much mass comes to a dead stop, Lieberman says. The lower leg stops suddenly on impact in addition to part of the foot.

NewScientist, 2010