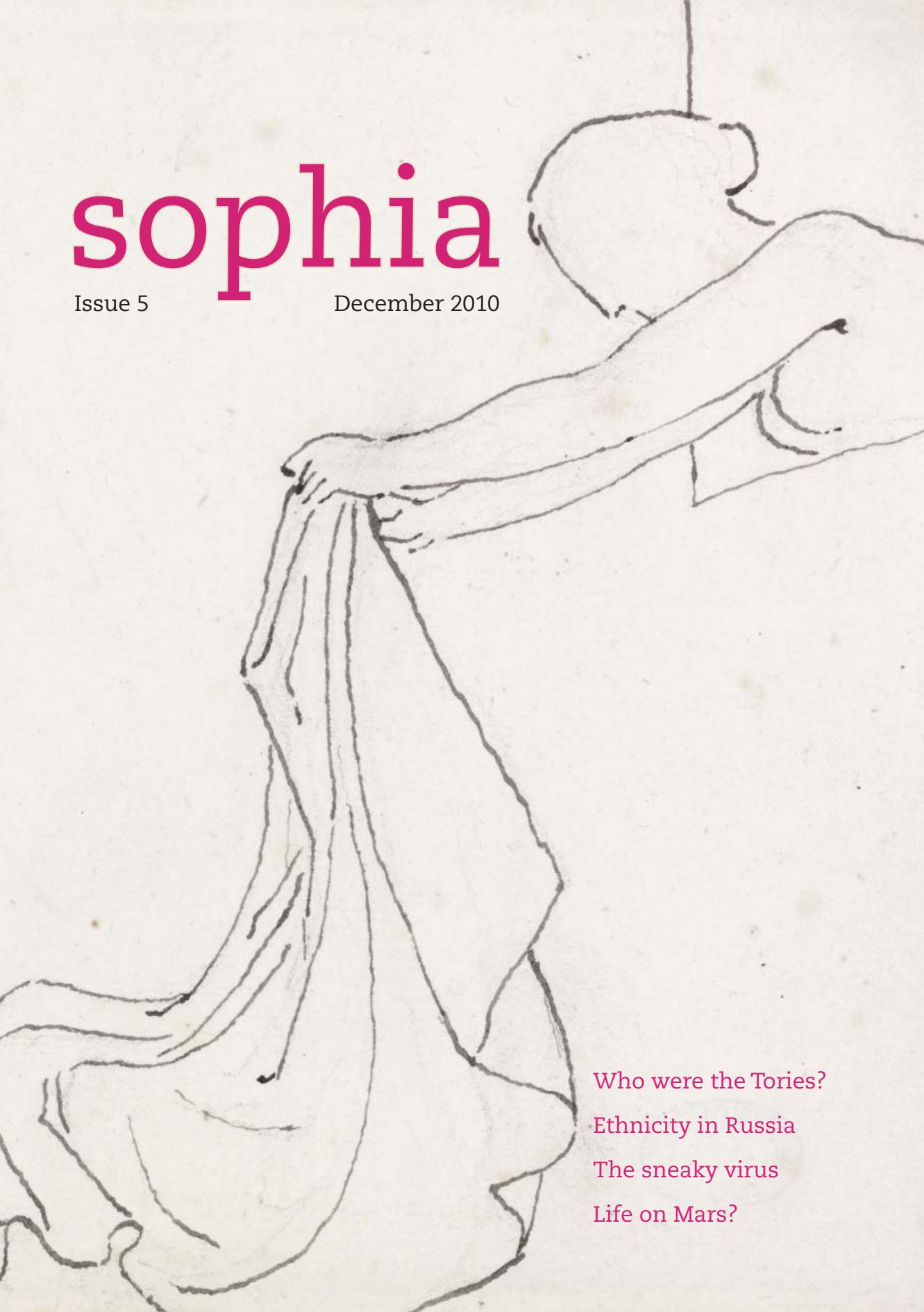
sophia

Issue 5 December 2010



Who were the Tories?

Ethnicity in Russia

The sneaky virus

Life on Mars?

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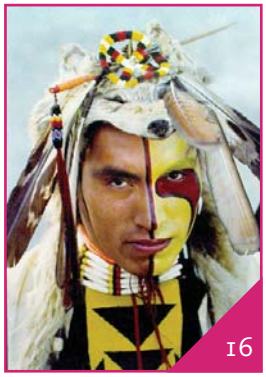

Cover image: Life, Action and Sentiment: John Flaxman on the art of modern sculpture. This exhibition celebrates the 200th anniversary of John Flaxman's appointment as the first Professor of Sculpture at the Royal Academy. On display are the many preparatory sketches Flaxman drew to work through his ideas on how to convey life, action and sentiment in three-dimensional form. Kept for reference at his studio, given to UCL by his family, these informal, linear drawings are shown together for the first time. They reveal Flaxman's almost obsessive dedication to his cause, the creation of a modern school of sculpture. UCL Art Collections, The Strang Print Room, South Cloisters, Wilkins Building, 21 June – 17 December 2010.

Credit: Andrea Fredericksen.

Editorial

Welcome to the first issue of *Sophia* since the beginning of the new term of parliament. With the Tories once again on the rise, Anna Bailey (page 8) discusses what the origin of the old term 'Tory' was and whether those who were historically labelled Tories also used the term to refer to themselves. At the same time, with likely reforms to the student finance arrangements in England and Wales, Zena Hadjivasiliou (page 6) asks what obligations British citizens feel to subsidise higher education through general taxation.

In the run up to the election, Gordon Brown ran into controversy over his altercation with a Rochdale pensioner over immigration issues, quickly dubbed 'bigot gate'. Questions of ethnic identity in Britain are often linked to immigration policy, but the Soviet Union had to govern a country made up of many long-established diverse ethnic groups ranging from Finns to Koreans. Federica Prina (page 18) explains how Soviet policy tried to link ethnicity to territory all under a single Soviet umbrella and how, in modern Russia, the government is trying to promote a sense of Russian citizenship as a single nationality, rather than as an ethnicity, and ongoing tensions between ethnic Russians and the large Muslim minority.

At *Sophia* we are pleased to be printing this issue in full colour again, for which we are grateful for donations from the Centre for Mathematics and Physics in the Life Sciences and EXperimental Biology (CoMPLEX), the UCL Graduate School, The Bartlett Faculty of the Built Environment, and the Faculty of Mathematical and Physical Sciences (MAPS).

Team

"I believe that there are plenty of wet rocks out there, smeared with microbial life"

Lewis Dartnell, p. 31

Sophia is a volunteer-run magazine aiming to showcase talent in research, writing and art from current UCL staff and graduate students.

By publishing academic content written for a general readership, *Sophia* hopes to encourage the sharing of ideas and an appreciation of the advances being made in areas of research other than our own; and to act as a forum for the discussion of academic issues and current affairs.

In creating *Sophia* we hope to provide opportunities for graduate students to begin writing about their work and for established researchers to write more creatively and for a broader audience than in a specialist journal. We believe that providing this platform will help contributors to develop as writers as well as giving readers an insight into the diverse spectrum of research taking place at the university.

If you are interested in submitting content then please contact the editor or relevant section editor. Submission guidelines are listed on our website:

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Interview with a Nuclear Waste Insider

In 'secret' locations, pools and bunkers filled with nuclear waste, accumulated from the 1950s onwards, fester and occasionally leak their dangerous contents. Their presence induces the questions, 'What to do with the waste?' and 'How do you only create safely stored nuclear waste in the future?'

The Decommissioning, Immobilisation and Management of Nuclear Waste for Disposal (DIAMOND) consortium funded by the Engineering and Physical Sciences Research Council (EPSRC) aims to answer these questions. In order to answer the question, 'What to do with the waste?' you first of all need to answer the question, 'What is the waste?' Regrettably the waste depositors of the 1950s did not leave detailed records. The DIAMOND project brings together people from wide-ranging fields with innumerable different skills in order to answer this complex problem.

DIAMOND held a meeting at Loughborough University on 29th April to allow individual members to report on their progress. UCL student, nuclear waste researcher and DIAMOND consortium member Krishna Hassomal attended to report on her research into how uranium interacts with organic molecules. Krishna's work focuses on a small part of this broad problem and is purely computational. Computational work on this topic is important as it perhaps removes or reduces the need to do more dangerous analogous practical experiments with radioactive material. Krishna was particularly enthralled by a line of research reported on examining the microbes which live in the nuclear waste pools purely because of her amazement at life finding a way to live in such a hostile environment. She also felt sympathy for a researcher trying to investigate the structure of a new storage material. The cement combined with super plasticisers is so tough it is defying characterisation by common techniques. (It gets stuck in whatever vessel you form it in.)

The conclusion reached by the meeting reflects the complexity of the problem and the difficulty of working with radioactive materials. Progress has been made in identifying the waste but it is far from complete and the ultimate answer to 'What to do with the waste?' is a long way off. As time passes pools and bunkers degrade and leak but not to be defeated the take home message from the conference was 'keep calm and carry on' with the important research.

Claire Skipper

Grand Designs

Partly to coincide with the release of his new book 'The Grand Design', and partly as a more general means of discussing his work, Stephen Hawking made a rare public appearance at the Royal Albert Hall last month. Being one of the most famous names in modern science, the event was bound to attract a range of fans, colleagues, and journalists of varying scientific background and the task of conveying his ideas to such a varied audience cannot have been easy.

Hawking began with a brief account of his life, peppered with pleasingly witty anecdotes about his childhood. He recalled being confused by the fact that he was taught not to start sentences with the word 'and', which a sample tally showed, was the most common sentence beginning in the Bible. He also mentioned that, due to a then 'progressive' method of teaching at his school, he didn't learn to read until he was eight years old, and gave an estimate of the time spent working at his undergraduate degree, as about an hour a day. Apparently, there's still hope for all of us!

Amusing as these reminiscences were, after half an hour they left little time or mental alertness to tackle the rather more intriguing thoughts of a brilliant mind on current science. By the time Hawking began to mention M-theory in the final minutes, yawns began to break out with some frequency from all corners of the hall. He finally concluded by stating that present thinking was that the universe could only be explained by a series of different theories, all overlapping, and demonstrated these thoughts with a series of maps, all overlaid to form the whole world picture. It is clear that Hawking aimed his talk far more towards the popular than the scientific end of the spectrum, possibly understandably so. It seems a shame, however, to miss such an opportunity to explain his ideas in greater detail to the curious amongst his listeners. Well, at least we received his book as part of the evening – hopefully that will be a little more directly scientific.

Maria Botcharova

Still no such thing as society?

As an EU student who received her university education in the UK, I felt the urge and obligation to attend the student march against education cuts on 10 November.

The debates that accompanied the rally and the government's decision to make immense education cuts left me with a lasting sense of frustration, disappointment and sorrow. The source of my confusion was not merely the realisation that many consent to or, worse, are passive to the changes that are about to occur. What shook me the most was coming face to face with the lack of a sense of society among many in the UK.

Many seem to associate any alternatives to raising university fees with themselves "paying for middle class kids' education". There is a certain irony in these people assuming that what they have achieved or earned is *exclusively* theirs and should be used for – and only for – their own benefit. We seem to dismiss the idea that anything we accomplish is done so in the context of society. The real principle; the real ideal behind any taxation is giving a little back to a society that has enabled us to progress. This is not just as a humble form of recognition but also a means of ensuring society will continue to encourage and allow us and others to advance ourselves.

Taxation that contributes towards an affordable higher education sets the foundations for a society whose citizens have fair and equal access to education. It ensures that the society the taxpayer lives in is one that stands for such principles as justice and equality where goods such as education are not a luxury.

Zena Hadjivasiliou

The Clapham Scribe

'Let there be gall enough in thy ink; though thou write with a goose-pen, no matter'

Sir Toby Belch to Sir Andrew Aguecheek
Twelfth Night, Act III, Scene 2.

Calligrapher Paul Antonio. Photo by Ed Long.

Despite the talk of moves to the 'paper-free' office, the technology of ink on paper has powered civilisation for millenia and continues to do so. Ed Long dropped into the North Lodge in the main UCL quad to find out more about UCL's 'Ink' exhibition and watch London-based master calligrapher Paul Antonio in action.

'If you ever see someone in a period drama writing with a feather, you know it's complete rubbish,' began calligrapher Paul Antonio, as he commenced construction of a quill pen by stripping the majority of the barb from the shaft of a goose feather, 'the feathery bit just gets in the way of your hand when you're writing.' He left a small tuft at the end of the feather which, he explained, was a useful tool for brushing debris from a page: using the hand risked smudging the ink, and blowing onto a page is strictly forbidden as the tiniest speck of saliva could ruin all your hard work. The combination of precision and flexibility afforded by a well-cut goose or turkey quill is yet to be matched by any manufactured pen, Antonio explained, as he ran through a quick demonstration of classical letterforms: *textura quadrata* (a gothic blackletter), Roman square capitals (reminiscent of carved stone lettering) and *capitalis rustica* (a more curved Roman style) using the newly made quill pen.

Paul Antonio's demonstration was part of an exhibition running just over a month in the North Lodge in UCL's main quad on the subject of ink. The exhibition combines a selection of artifacts from UCL's collections, personal possessions and new objects, many created in situ by 'live respondents' and added over the course of the exhibition.

Antonio effortlessly combined a fluid practical demonstration with a non-stop running commentary; by turns technical descriptions, life stories, jokes and rants about corporate customers unused to dealing with the pace of old-world technology. Born in Trinidad, with more ethnic heritage than I can now remember (but certainly including Chinese, Sudanese, Spanish and Carib) he studied calligraphy and type history both at home and formally at Reading and Birkbeck before firmly establishing himself as the go-to guy for calligraphy and hand-lettering in London and counting Tiffany & Co. and Louis Vuitton among his clients. He has lived in several countries, but you get the impression that he's equally at home anywhere with a scribal tradition: just as comfortable with a reed pen and papyrus; a brush, ink and rice paper or a goose quill and vellum. In addition to Roman scripts, he has studied Arabic, Chinese and hieroglyphic writing forms in his years of study.

Although much of calligraphy is considered an old-fashioned practice, Antonio spent the majority of his sitting demonstrating more modern techniques which, nevertheless, hint at the classical blueprint or *ductus* of the letter. Although I say 'sitting', these techniques were much more physically active as he moved around to change the pen angle between each stroke. This differs from classical techniques where the broad and thin strokes occur at the same angle throughout. The modern approach also made much use of dragging ruling pens and automatic pens, held orthogonal to the paper, to create deliberately rough, saw-tooth edged strokes and energetic splatters of ink in the direction of travel.

Developing new styles often takes calligraphers hours of experimentation and practice to find something that is both dynamic and balanced in its form, but Antonio's skill is the ability to do the planning in his head before putting pen to paper. Over the hour that I watched I didn't see a single slip and at most saw the odd 'dry' tracing of a stroke before committing it to ink. From the basic letter structure, he then built up the work by adding flourishes: spirals; lines dragged out using the edge of the nib from pools of ink; bracketed serifs and curves based on Hogarth's 'line of beauty' – for which a 55° angle is best, apparently. He also used drops of strong bleach to 'open up' parts of the letter producing an unpredictable mottled brown effect inside the stroke, with a strong black outline still intact.

The 'Ink' exhibition, curated by Simon Gould and Rhiannon Armstrong, is running until 11 December and Paul Antonio will be back again before the end to demonstrate composing longer pieces of text in blackletter.

There wasn't much evidence of any 'gall' in Antonio's penmanship, but there was certainly plenty of practical talent sitting on top of a deep academic understanding of the history of his craft. It will be fascinating to see how this exhibition develops over the next several weeks.

Ed Long

Websites

1. www.ucl.ac.uk/museums
2. www.paulantonioscribe.com

Just Who Were the Tories?

Why do we call members of the British Conservative Party 'Tories'? The term is so deeply ingrained in our political vocabulary that we rarely stop to question its origins. All of our other political labels – 'Conservative', 'Liberal' and 'Labour' – actually *mean* something as words in their own right, whereas, on the face of it, 'Tory' doesn't seem to mean anything at all. Where, asks Anna Bailey, did this strange word come from?

James II (whose succession to the throne was supported by the Tories) with his wife Anne Hyde, painted by Sir Peter Lely, 1660s.

The term 'Tory' predates 'Conservative' as a political label by some 150 years. 'Conservative' dates from around 1830, and was initially used to label those politicians who were opposed to the Great Reform Act of 1832 – extending the right to vote to some sections of the middle classes. 'Tory', by contrast, dates from the end of the reign of King Charles II in the late 17th-century. Originally slang for Irish cattle thieves, it was used as an offensive nickname for the opponents of the Exclusion Bill, which sought to prevent King Charles II's brother James from succeeding him as king, due to the fact he was a practising Catholic. Instead, 'exclusionists' wanted Charles to be succeeded by a suitable Protestant. Although the Tories themselves were almost entirely Anglican, their opposition to the Exclusion Bill lay in their sympathy for 'natural' rights of succession, and fear of the resurgence of civil strife that had surrounded the Civil War of 1641–51.

James did succeed Charles II (as James II), but the Whigs were triumphant in the end: James made himself so unpopular with his anti-Anglican policies that a plot was launched against him. A group of parliamentarians invited the Dutch Protestant William of Orange, who happened to be James' son in law, to 'invade' England. James fled the country and William was crowned King.

The succession question did not end there, though: James' younger daughter Anne succeeded William, but failed to produce an heir. A new crisis was provoked in 1700 when her only son to survive infancy died aged 11. Fearful that James II or his son would have a strong claim to the throne upon Anne's death, Parliament passed an act that legally established George Louis, the Elector of Hanover – a distant German-speaking Protestant relative – as Anne's heir. Some Tories opposed the act owing to the remoteness of the Hanoverian claim on the throne, and clung to the hope that James II's son would convert to Protestantism to become king. This opposition backfired when George was crowned king in 1714: he excluded all Tories from his government, and the Whigs became the sole governing party.

Political historians during the first half of the 20th-century, influenced by the long-term endurance of the term 'Tory', tended to assume that a Tory party existed continuously from the time of the Exclusion Crisis through to the 19th-century, with the party being renamed 'Conservative' in the 1830s. The contemporary view, however, is that there was no continuous Tory party existing from the late 17th to the early 19th century. The longer the Tories were excluded from office under the reigns of George I and his son George II, the more their numbers dwindled; and because the old political issues which had given birth to the term gradually became accepted as having been settled by the Hanoverian succession, the word came to be meaningless as a political label. Most historians now consider that Tories ceased to exist by the early 1760s.

It is important to remember that political identities at this time were highly ambiguous. Whereas our modern political parties have a formal legal existence, parties in the Hanoverian era were simply groups of politicians who acted together informally. Applying a political label to a group of politicians was often a matter of perspective: even contemporaries debated which parties existed, and a large number of politicians were independent and belonged to no party.

The ambiguity of political identity at this time makes dating the origins of political parties an imprecise task. The Conservative historian Lord Blake saw the origins of the modern Tory party in the political crisis of 1782–4, when the Whigs split into those who followed Charles James Fox, and those who followed William Pitt the Younger. Pitt was British prime minister from 1783 to 1801, and it was his followers who gradually consolidated to form the modern Tory party. Blake notes, however, that it was at least another thirty years before this political grouping came to be called 'Tory' rather than 'Pittite'; indeed, Pitt always regarded himself as a Whig. So how did the political label of 'Tory' come to be revived in the early 19th-century, and should the party it denoted be regarded as in any way related to its namesake of some hundred years previously?

From around 1818, 'Tory' crept back into the political vocabulary, and by the final years of Lord Liverpool's tenure as Prime Minister in the mid-1820s, reference to a 'Tory party' was commonplace. With the Foxite Opposition increasingly self-styling themselves as 'Whigs', it appears that 'Tory' re-emerged as the natural term to label the Whigs' opponents.

Up to the early 1820s, it was mostly Radicals who used the labels 'Whig' and 'Tory'. Thus, language that was to eventually become part of mainstream political life started its comeback on the fringe of that arena: the radical left.

While many mainstream politicians at this time – especially supporters of the Liverpool government – saw themselves as being 'above party' and simply serving the King in his choice of government, the outsider Radicals portrayed things differently. The notorious republican journalist William Hazlitt depicted politics in 1819 revolving round party warfare, and saw politicians divided clearly into a Tory/Whig dichotomy. The Tory and Whig sides, wrote Hazlitt, 'have quarrelled so long that they would be quite at a loss without the ordinary food of political contention.'

Blackwood's Edinburgh Magazine and the *Quarterly Review* were the two major right-wing journals at this time, yet it was well into the 1820s before they began to use 'Tory' as a regular label. George Croly wrote a series of political analyses for *Blackwood's* between 1820 and 1823. The term 'Tory' rarely appeared in Croly's lengthy analyses; rather, he referred to the 'administration' or 'minsters'. On one of the rare occasions that 'Tory' did appear in a Croly piece, it was only to comment on what he believed was the absurdity of the name as used by others: he referred to 'our friends the Tories (as they are absurdly enough called, for want of a better name)'. Nevertheless, 'Tory' was on the verge of re-entering mainstream political vocabulary: in 1822 the *Quarterly Review* referred to those 'parties … which are known among us by the names of whig and tory'. By the end of 1823 *Blackwood's Magazine* had even started to describe itself as 'Tory', although it is clear that at this stage it was using the term to denote a creed rather than a Parliamentary party.

The gradual reappearance of the terms 'Whig' and 'Tory' in political vocabulary was far from uncontroversial. Only towards the end of Lord Liverpool's premiership did complaints about the usage of the terms 'Whig', and especially 'Tory', die out. The problem for the 19th-century Tories was that the core of their philosophy was dedication to the constitution in its current form: the constitution established by the Hanoverian succession of the *Whigs* more than 100 years previously. The modern Tories thus saw themselves as the true descendents of the 18th-century Whigs. The 'Tory' name, by contrast, was associated with Catholic Jacobite rebellion in the 18th-century: everything those who now found themselves being labelled 'Tories' loathed. The prevailing view of the Liverpool government's supporters is neatly captured by a correspondent in *The Times* in 1814:

> 'The whole nation are, in the best sense of the word, "Whigs" [i.e. supporters of the Hanoverian succession] – and if the term "Whig" has been dropt, as a national appellation, it is because "Tory," the correlative, exists no longer. The assumption or resumption of the name by this Foxite party, is an ill-timed and disingenuous conceit … [I]t is but blaspheming … to use it as the watch-word of a *new* faction, capable of rivalling the ancient Whigs in none but their most disgraceful proceedings.'

As late as 1818 *Blackwood's Magazine* was unhappy about the Opposition's appropriation of the name 'Whig':

> '… the Opposition Party in Parliament … still fantastically retains the unsubstantial and unmeaning appellation of "The Whig Party." Why should they profane this once venerable name? What have the Opposition of our times in common with the lofty and considerate spirit of the great authors of the English Revolution, the proud conquerors of the independence of Europe?'

Yet even *Blackwood's* reluctantly admitted that it was forced to go with the flow of increasingly common usage. It grudgingly referred to, 'the present "Whigs," – since, for the sake of distinction, they must be called by that name,' and having made its complaint about the name, the offending inverted commas were dropped thereafter.

The rehabilitation of 'Tory' continued to be controversial for several years after its counterpart 'Whig' became generally accepted. At first, those who were branded Tories by their opponents refused to accept the name. A close political friend of Sir William Curtis (a City of London MP) bemoaned the nickname of 'Tories' being applied to Ministerial supporters. *The Times* reported:

> 'The friends of Sir W. Curtis were friends to the constitution. Their adversaries called them Tories; he denied that they were so. None of them advocated the divine right of kings, or doctrines of that nature. He said they were the Whigs of 1688.'

Once the term had stuck by the mid-1820s, the newly christened Tories slowly came to take pride in their name. It was essential to their identity, however, to emphasise that they were in no way related to their 18th-century namesakes. George Croly of *Blackwood's* commented:

> 'the name of Tory was once obnoxious from its connexion with the dangerous and exploded doctrines of the Stuarts. But time changes the spirit of titles as well as of men. Toryism, in 1823, is the representative of Whiggism in 1688.'

Naturally, their opponents were determined to refute this view and link the Tories with their treacherous namesakes of a century previously. In 1824 the Whig-supporting *Edinburgh Review* wrote:

> 'An affection of courtly principles is becoming more prevalent than formerly, among certain politicians who used to be satisfied with supporting bad measures because they were in place, or dependants on placemen, without pretending that they did so on the principles of the Tories, who a few years ago would have been treated as rebels.'

Gillray, the most famous political cartoonist of his day, depicts William Pitt resigning from office in 1801.

But the right-wing journals were not to be diverted from one of their favourite themes quite so easily. In 1830 the *Quarterly Review* quoted with approval the observation of the historian Lord Mahon that, in the reign of Anne:

> *'…the two great contending parties were distinguished, as at present, by the nicknames of Whig and Tory. But it is very remarkable that in Queen Anne's reign the relative meaning of these terms was not only different but opposite to that which they bore at the accession of William IV… The same person who would have been a Whig in 1712 would have been a Tory in 1830.'*

Interestingly (although perhaps unsurprisingly), one of the few Tories at this time who *did* see themselves as descending from their 18th-century namesakes was the maverick young Disraeli, who went on to become one of the most famous Conservative prime ministers in British history. In his 1835 essay 'Vindication of the English Constitution' Disraeli regarded Bolingbroke – a prominent early 18th-century Tory politician – as the founder of the Tory tradition.

As we have seen, 'Tory' only began to re-enter mainstream political vocabulary in the early 1820s. Even then, it tended to be those *outside* Parliament (e.g. political commentators) who identified themselves as Tories, rather than ministers themselves. So should we regard the Liverpool administration of 1812–27 as a Tory government? On the whole, historians tend not to have labelled it as such. JE Cookson, in the introduction to his study of the Liverpool administration, writes 'I have not made a habit of referring to the ministerialists as 'Tories' because this was apparently rare.' But political commentators usually did use the term in retrospect: both *The Times* and the famous political diarist George Greville were referring to the old Liverpool ministry as 'Tory' soon after it ended in 1827.

Once Liverpool's government had generally come to be regarded as 'Tory', it is remarkable how quickly the ascription of 'Tory' spread back even further, to the premiership of Pitt in the late 18th-century and even beyond. By the time the eminent Whig politician Lord John Russell made his famous Stroud election victory speech of 1837, in which he referred to 50 years of 'Tory administration' from the time of the Younger Pitt, he was merely repeating received wisdom. This is also evidenced by the fact that the Tory political commentator Croker, criticising Russell's speech in the *Quarterly Review*, rebuked him for referring to 'the two great parties, Whig and Tory' as 'nicknames'. They are so much more than nicknames, insisted Croker; they are 'the two *great antagonistic principles* which have been struggling in this country for two hundred years.'

Perhaps the most important lesson of this brief review of the history of the term 'Tory' is that there are no clear, definitive political identities. Political labels and party histories during this period were highly changeable, and were continually contested and reinvented to suit the needs of politicians and journalists of the day. Labelling Liverpool's government 'Tory' is relatively unproblematic given the frequency with which it was described as such by contemporaries in its later years and in the years immediately after its fall. To label Pitt's government 'Tory' would certainly be atypical of the time, even though it is no stretch to regard it as an ancestor of the modern Conservative party. Historians today see no connection between the Tories of the late 17th and early 18th centuries and their namesakes from the 1820s onwards; and as we have seen, the latter were horrified at the suggestion of such a link. Nevertheless, more recent eminent Conservative politicians such as Disraeli and Churchill saw themselves as part of a Tory political tradition stretching back to the Tories of Charles II's reign. A combination of their influence and the common name seems to have been sufficient to earn the original Tories a place in popular histories of the Conservative Party.

Anna Bailey is a PhD student at SSEES

Further reading

1. JJ Sack, *From Jacobite to Conservative: Reaction and Orthodoxy in Britain, c.1760-1832*, 1993

2. F O'Gorman, *The Emergence of the British Two-Party System, 1760–1832*, 1982

3. JCD Clark, A General Theory of Party, Opposition and Government, 1688–1832, *The Historical Journal*, 1980

Perception in War

What is the function of camouflage? Craig French discusses the relationship between knowledge and visual perception: through a series of war-related examples, he encourages us to take a philosophical perspective on what 'seeing' can really mean.

It is fundamental to our nature that we are perceptive beings. Perception affords us knowledge, making it possible for us to act and live in the world. One way to appreciate the importance of perception is to appreciate that it can make the difference between life and death (we are taught this from childhood when we are taught to look and listen when crossing the road, *even if* the green man is showing!). An extreme way to bring this into view is to consider some aspects of perception as it occurs in war. It is fundamental that a soldier acting in combat – e.g. fighting or covert surveillance – has perception in combat (e.g. seeing an enemy). The crucial role of perception in military combat is clearly recognised by developers of military equipment. An interesting case is the role of camouflage, as we shall discuss.

In a recent article on the BBC News website there was a report of a change in the British Army's uniform. What is the significance of a soldier in combat having a camouflaged uniform? Intuitively, wearing a camouflaged uniform will enable a soldier to 'blend in' to a background. But what effect does this have on the enemy's perception of the soldier? A natural response to this is that such camouflage prevents the enemy from seeing the soldier (this will severely limit the enemy's capacity for targeted attacks on the soldier). Such thinking may be behind the remark by Corporal Adrian Gibbs, from the Grenadier Guards, quoted in the BBC report: 'This new uniform will make it *harder for us to be seen* and so much easier for us to do our job' (emphasis added). In philosophy one finds remarks in the same spirit. From Susanna Siegel, Professor of Philosophy at Harvard University: 'when a thing is camouflaged, you can't see it' (see further reading).

Suppose that there is a large dome in a hilly landscape. Now, suppose that the dome is a huge military communication satellite, and so for reasons of security has to be camouflaged. Let's assume that the dome is camouflaged in that it is made to look like one of the other hills in the area. Intuitively, if the dome is made to look this way it will blend into the background. We might say: made to look like a hill it just fits (looks-wise) into this landscape in the way that a dome wouldn't. Imagine London's millennium dome put in the middle of a picturesque hilly part of the English countryside; it clearly wouldn't blend in! The dome is camouflaged, so how does this affect the enemy's perception of it? It is quite inaccurate in this case to say that the enemy cannot see it. On the contrary: the enemy sees it, and in seeing it mistakes it for just another hill. The effect of the camouflage in this case is to prevent accurate identification by visual means. So, we shouldn't think that quite generally the effect of camouflage on seeing is that of preventing seeing.

It is clear that the dome being made to look like a hill is a way of camouflaging the dome. But one might respond: the sense in which the camouflaged soldiers are said to 'blend in' is quite different. And so there are two senses of camouflage in play. I agree, so, in what sense shall we say that the soldiers are camouflaged such that there is a difference between that case, and the case of the dome? The soldiers blend into the background in such a way that one cannot visually detect the difference between the soldier and the background. This is not true of the dome, since one *can* visually detect the difference between it and its background: it is a visually distinguishable aspect of its environment. Perhaps, then, one can make the following kind of generalisation: when the camouflage in question is such that something

being camouflaged means that someone cannot see the differences between it and its background, then one cannot see it.

But even with this second sense of camouflage the generalisation is false: consider a soldier, Christoph, who knows all of the details of the military parts of a large stretch of countryside. Suppose he is walking through this countryside with an acquaintance who lacks such knowledge, Ann. Now, suppose that they stop in the middle of a field. As it happens, and as only Christoph knows, they are standing on the camouflaged roof of an underground base. Suppose that for whatever reason, they both happen to be looking down at the grass. Their visual fields are occupied mostly by the camouflaged roof, but also parts of the field immediately surrounding the roof (but, we shall assume, nothing else). So, the roof is not visually distinguishable from its immediate surroundings and so is camouflaged in the second sense. If we adhere to the above generalization then we will have to conclude that neither Christoph nor Ann see the roof. But this is implausible: Christoph knows he is on the roof. Imagine he says to Ann, pointing downwards: "that's the roof of a base, it's made to look like part of the field". Unless Ann misunderstands this information it would be quite odd for her to say "I don't see it". She does see it, as does Christoph: they are looking down right at it. What the camouflage does is put limitations on their capacity to visually identify it as a roof, but they still see the roof.

I am not suggesting that there are no instances of camouflage (in either sense) that *do* prevent seeing. I have argued that we should not accept generalisations to the effect that camouflage prevents seeing. One line of thought that might be pursued on the basis of these considerations is that there are (at least) two senses of 'seeing'. One is related to identification or recognition. I may be unfamiliar with the different species of badger. So, when confronted with many badgers, all of different species, and asked 'do you see the ferret badger?' I would say no. And this claim would be true (in the sense of 'seeing' in play), since I could not identify or recognise any particular badger as a ferret badger. In a more primitive sense of 'seeing', which doesn't require identification or recognition, my claim is false, since it is true that I see the ferret badger: it is one among the many badgers, all of which I see. What to make of this final suggestion I am unsure. But I hope to have shown by reflecting on perception in war that generalisations such as 'when a thing is camouflaged, you cannot see it' are not as straightforward as they appear.

Craig French is a PhD student in the Department of Philosophy

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Multi-Terrain Pattern camoflauge (right), designed to replace the Disruptive Pattern Material (left) for use by the British Army in 2009.

Warriors of the Plains

'Living Heritage' is a fashionable term which today is usually applied to intangible cultural heritage – knowledge, skills, crafts, performance and spoken language – rather than to the material objects that form the collections of the world's museums large and small. Revived traditional celebrations like Native American *pow-wows* and Polynesian hula dancing festivals are now deemed to be the true and – some argue only – authentic embodiments of the culture of the communities they represent. But while it is good that these celebrations and arts so long suppressed under colonialism should now be reinstated, intangible cultural heritage casts a shadow over museums, making them seem outdated, the living tombs of dead cultures, full of objects that no longer have a story to tell. Museums increasingly stage cultural performance activities in their forecourts and grounds, but the challenges posed by contemporary culture to the classic style of museum gallery presentation is all too often left unaddressed. The recent *Warriors of the Plains: 200 Years of Native North American Honour and Rituals* exhibition at the British Museum, curated by Max Carocci and open from 7 January to 5 April 2010 showed how thoughtful juxtapositions of the old and the new within the gallery framework can be used to develop an exciting new kind of exhibition. While displaying inbuilt links to the communities represented and their ongoing cultural performances, it also provided the visiting public with expanded possibilities for engaging with the objects and their communities, retaining at the same time the deep sociocultural, historical and artistic context which only museums can provide.

The first exhibition of Native North American culture at the British Museum since 1994, Warriors of the Plains focused on the peoples of the Great Plains from 1800 to the present, drawing upon the British Museum's collection of ceremonial and military regalia, weapons and accessories, painted hides and ledger drawings, many on show for the first time. Honour, ritual and identity were the organising principles of the exhibit, embodied in beautifully chosen and displayed objects and interwoven in a narrative of continuity and change. Two cases were positioned in complementary opposition: one containing implements of war, the other smoking pipes of peace, the latter far more beautifully decorated and regarded as more valuable by their makers and users. These were indeed warrior societies, but as the display of weapons such as coup sticks showed, killing was neither the original nor the only objective of raiding parties. Coup sticks were clubs used to 'count coup' or touch an opposing warrior after sneaking up on him, a kind of symbolic kill that was sufficient to fulfil honour. It was only after the arrival of Europeans that killing became an invariable part of the warrior's campaigns.

After following the changes in warrior society during the contact and colonial periods, the exhibition moved on to show how the Plains warrior ethic continues to flourish in the 21st century. Two emblematic objects stood out for me. One was the dance regalia of award-winning Native American *pow-wow* dancer Dennis Zotigh. This flamboyant costume enhanced with feathers, beading, tassels and symbolic embroidery repeated the motifs that had appeared on all the warrior regalia of the preceding two centuries and thus showed the continuity between past and present, linking the museum and its collections to the dancing grounds and peoples of today. Zotigh performed a dance in the costume during the rituals that opened the exhibition, and the costume on display seemed still to reverberate from the drumbeats, poised at any moment to take to the floor again. The second emblematic object was sober khaki World War II army uniform worn by the late Gus Palmer, a senior member of the Kiowa, who was responsible for restarting the Kiowa Black Legging warrior society, part of the Native American renaissance. An example of Black Legging society regalia was shown next to the uniform, the spirit of each clearly informing the other, an intriguing juxtaposition that, through its understatement, was deeply moving and powerful. Of these two remarkable costumes Carocci says: 'Each in its own way epitomises a way of maintaining identity. Ethnic or national – they are like strings that tie people to the past and customs of their ancestors. *Pow wow* regalia derived directly from warrior society regalia, and warrior societies' accoutrements directly linked to soldier activities testify to the resilience and adaptations of complex and multilayered notions of identity.' Although this superb exhibition has now closed, the following pages show *pow wow* dancer Kevin Hawaye of the *Assiniboine* or *Stone Sioux* people in traditional face paint and the skin-shirt of *Mkaisto* or *Red Crow*: the chief of the Blood tribe in the late 19th century.

Dr Kaori O'Connor is a Senior Research Fellow in the Department of Anthropology

Kevin Hawaye of the Assiniboine or Stone Sioux people in traditional face paint. Image credit: © The Trustees of the British Museum

The skin-shirt of Mkaisto or Red Crow: the chief of the Blood tribe in the late 19th century. Image credit: © The Trustees of the British Museum

Ethnic Engineering: The Legacy of Soviet Policy on Ethnic Minorities in Contemporary Russia

In the wake of the Moscow underground suicide bombings, Federica Prina explains how Soviet nationality policy played a huge role in forging ethnic minorities' identities in the USSR, the legacy of which is still being felt strongly in today's Russia...

On 29 March 2010 two explosions in the Moscow underground killed 40 people and left another 80 injured. Suspicions immediately fell on Russia's highly volatile North Caucasus region, where in recent years anti-Russian rebellion has transcended ethnic lines, spreading out from Chechnya to other Muslim republics of the Russian Federation, notably Dagestan and Ingushetia. Sure enough, Russian officials soon identified two Dagestani women as the suicide bombers. The women were reported to be so-called 'black widows' – widows of rebel fighters killed by the Russian security services in the North Caucasus. This turbulent region of Russia is already familiar to many in the West from the two Chechen wars of 1994–1996 and 1999–2000, when Russian military forces entered the republic to re-establish federal control and quash Chechen attempts to break away from Russia and establish an independent republic.

Suicide bombings, freedom fighters and war in the North Caucasus are the most dramatic manifestations of ethnic divisions in the Russian Federation. As such, they are the images that are presented to us in the Western media. Yet they are only the most visible aspects of the extremely complex majority-minority relations in Russia today. Overt discrimination against certain ethnic groups is also a major issue. Darker-skinned ethnic groups from former Soviet republics of the South Caucasus and Central Asia (such as Azerbaijan, Kazakhstan and Georgia) have found themselves particular targets for discrimination and abuse, including by the police. One study in 2006 found that the Moscow police are guilty of 'ethnic profiling', with darker-skinned people being 22 times more likely to be stopped for checks than whites in the Moscow underground. Even more disturbingly, in a few extreme cases dark-skinned individuals have been attacked and even murdered by neo-Nazi groups. The 'identity crisis' experienced by ethnic Russians in the wake of the fall of the old Soviet superpower, not to mention the enormous ideological vacuum left by the end of Communism, have been suggested as leading to the rise of nationalist sentiments in modern Russia.

The nature of ethnic divisions in contemporary Russia is deeply entrenched in the country's history. In particular, Soviet policies forged a fundamental link between ethnicity and territory, shaping the structure of the Russian Federation that still exists today.

The 'Nationality Question'

Russia is highly diverse: twenty percent of the population has an ethnic background other than Russian. Minorities as diverse as Finns, Turkmen and Koreans make up present-day Russia, with a corresponding plurality of cultures, traditions and languages. The Muslim minority is substantial, with approximately half of Russia's minorities belonging to this faith. The structure of the Russian Federation is also extremely complex. Like the United States of America, Russia has a federal system of government. But unlike the 50 states of the USA, Russia's 83 territorial units (*subjekty*) do not enjoy equal status. Instead, they are divided into categories reflecting different levels of autonomy. Notably, 21 of the 83 *subjekty* are ethnic republics which have their own constitution, president and parliament.

Given its vastness and diverse ethnic make-up, Russia has always being confronted with the so-called 'Nationality Question' throughout its long history.

In the 14th century, the Russian *ethnie* was already mixed, with the Slavic-Scandinavian people of *Moscovy* (the medieval state of the Grand Duchy of Moscow) living alongside Turkic people. The Russian Empire's diversity only grew as more territories (and thus peoples) were annexed into the empire.

The advent of Communist rule from 1917 saw a comprehensive and highly institutionalised ethnicity policy adopted throughout the Soviet Union. All forms of oppression, it was claimed, would be brought to an end under Communism: Lenin's 'Declaration of the Rights of the Peoples of Russia' contained guarantees of self-determination and equality. To put this into practice – while containing ethnic tensions and spreading the Communist doctrine – the Soviet Union devised a system that effectively institutionalised ethnic diversity. Russia was divided into territories, several of which were 'assigned' to ethnic groups, called 'titular nationalities' – for example, the Tatar Autonomous Soviet Socialist Republic was 'assigned' to the Tatars. At the root of all nationality policies was the link between ethnicity and territory, derived from Stalin's definition of a nation as, 'an historically evolved, stable community based on a common language, *territory*, economic life and psychological make-up manifested in a community of culture.'

Soviet 'Ethnic Engineering'

Scholars such as Eric Hobsbawm, Benedict Anderson, Adrian Hastings and Max Weber have viewed national identity as an invention. Institutions can play a role in constructing national identities, although institutions themselves are mutable, influenced by changing circumstances. The ethnic consciousness of peoples in the Soviet Union was heavily influenced by Soviet institutions, through a process of 'ethnic engineering'. The Soviet Union's first years saw a frantic scientific study of its nationalities. Statisticians compiled lists of ethnicities and their languages; census takers recorded data on nationalities and their members; while ethnographers delineated specific cultural, linguistic and physical characteristics for each group. The notion was that these data would enable each person's ethnic group to be determined without fail. These efforts succeeded in establishing distinct ethnic categories, which have shaped groups' self-perception and their position in relation to others.

Three institutions in particular played key roles in the process of creating ethnic identity: the Soviet passport, educational institutions, and the local administration in 'ethnic' republics. Firstly, in addition to citizenship the Soviet passport recorded (and thereby fixed) one's ethnicity, which was then continually reproduced in all documents concerning an individual. Secondly, educational institutions provided native-language education, as language was considered the predominant ethnic marker in the Soviet Union. Finally, the ethnic republics' local administration was staffed with representatives of local minorities, through a process of *korenizastyia* (literally 'taking root', or indigenisation). The transfer of powers from the centre to the periphery has been described by Terry Martin as 'the most ambitious affirmative action programme in history', and penalised non-titular nationalities, including ethnic Russians. In doing this the Bolsheviks had an ulterior motive: they hoped to gain the support of local ethnic elites, bringing them into the fold of the Communist Party to administer their republics and regions whilst remaining loyal servants of Moscow. The result was that minorities soon learned to use the vocabulary of ethnicity in their exchanges with the majority, to claim privileges deriving from their status as a titular nationality.

Empty policies

Yet despite the apparent sensitivity to cultural diversity and the promotion of indigenous cultures, the actual 'ethnic content' of Soviet nationality policies was limited. The regime's main objective was the promotion of Communism. Ideology took precedence over nationalistic (including Russian) sentiments: the wishes of nationalities had to be kept within pre-established boundaries. Stalin's slogan was 'national in form, socialist in content'. Thus, the focus was on superficial events such as ethnographic exhibitions and dances, and apolitical activities such as the study of literature in the local languages.

The inadequacy and superficial nature of Soviet ethnic policies meant that nationalities' deeper nationalist feelings were truncated in a number of ways.

Firstly, members of ethnic minorities were deprived of true political representation at the federal level: a legacy to be found in post-Soviet Russia. Secondly, the freedom to choose one's ethnic nationality was denied as it was viewed as biologically inherited from parents, in line with the Soviet *primordialist* view of nationalism. Thirdly, the wishes of the minorities themselves were often ignored when nationality policies were formulated. As several non-Russian nationalities were considered 'backward' and at different stages of development, Soviet leaders adopted paternalistic and patronising attitude towards them. Linguistic policies required minorities to learn and employ a mother tongue determined by one's nationality, regardless of personal linguistic preferences and habits. Media in 'local' languages was not always what people wanted - an example is the (literally) overnight replacement of Russian-language press by the Ukrainian language in Odessa which, although located in Ukraine, is primarily Russian-speaking. Fourthly, Soviet leaders repressed a number of ethnic groups' cultural traditions. Groups were forced to work in collectives, even when it was contrary to their age-old traditions. Religion was repressed, with the killing of priests and the closure of churches and mosques, as it was believed that religious institutions could impede the realisation of the Communist ideal.

Hence, Soviet nationality policies were ultimately incoherent: although local cultures were formally promoted, ethnic minorities were simultaneously subjected to repressive and deeply traumatic measures. One of the most extreme cases was the mass deportation of entire ethnic groups during the Stalin period. Accused by Stalin of collaboration with the Nazis during World War II, or resistance to Soviet rule, minorities were deported to Siberia or Central Asia, where they were subjected to forced labour. These included, among others, minorities such as Germans, Poles, Koreans, Chechens, Ingush, Crimean Tatars and Finns. Soviet nationality policies were also ineffective in accommodating minorities' needs, including by rejecting the spontaneity of change and the fact that nations have porous imaginary borders that (often willingly) absorb external influences. The failings of the system led to resentment and, in many cases, ethnic mobilization starting from the *perestroika* period under Gorbachev (1980s), which in turn further strengthened various groups' consciousness as nationalities distinct from Russians and other ethnic groups. This is regarded as one of the factors comprising the political instability that led to the Soviet Union's downfall.

Post-Soviet Realities

To contain ethnic tensions, post-Soviet Russian presidents (Yeltsin, Putin and now Medvedev) have tried to promote a civic – as opposed to ethnic – form of Russian nationalism, by giving precedence to the concept of *rossiiskii* (Russian citizens) rather than *russkii* (ethnic Russians). Within this conceptual framework, all ethnic nationalities can be encompassed in an overarching notion of Russian citizenship. Nationalities enjoy much more freedom than they did in the Soviet Union: according to the Russian Constitution, nationality is now based on self-identification rather than being biologically inherited, and one can choose the language of education. However, this has not, in practice, meant that deeply-entrenched ethnic divisions have been overcome. For example, the leaders of Tatarstan and Bashkortostan (two ethnic republics within Russia) protested when the new Russian passport, adopted following the USSR's collapse, discontinued the Soviet tradition of specifying ethnicity in identity documents.

The Soviet link between territory and ethnicity proved ineffective in accommodating minorities' rights since, as Rogers Brubaker notes, '[n]ations are fundamentally groups of persons, not stretches of territory'. There is an excessive rigidity in the primordialist perception of ethnicities which is still predominant in post-So-

viet Russia. This views national communities as genetically determined rather than 'imagined'; trapped in old paradigms rather than based on personal perceptions of one's identity. The reliance on fixed criteria such as 'origin' or 'race' for classification restricts people's ability to shape a multi-faceted, mutable identity. Yet this Soviet legacy is a powerful one, which continues to impair the formation of a more harmonious multi-national community in Russia.

The current situation is complex. Privileging titular nationalities within their 'own' territories can result in discrimination against the other nationalities who live there. At the same time, Putin's policies of centralisation – which have been continued by his hand-picked successor, President Dmitryi Medvedev – have reduced the autonomy of the regions, including their ability to make independent choices on policies for the preservation of local cultures. These reforms have included the harmonisation of ethnic republics' regional laws with federal law; the abolition of the election of regional governors in favour of direct appointment by the president (an unconstitutional decision); and the merger of some ethnic regions with Slavic ones.

The beneficial nature of some of these measures cannot be denied: the rule of law is hardly possible in a country that has a mass of contradictory laws, and where regional leaders may abuse their powers for personal gain. Yet many advantages are only illusory. Rather than providing genuine independence from the centre, reforms have often transferred dependence from region to centre, extending the reach of the Kremlin's so-called 'power vertical'.

These reforms have provided Moscow with much scope to rob municipalities of their autonomy. An example is a 2007 amendment to federal education law, which removed the regions' responsibility for decisions on the teaching of language, history and culture of non-Russian nationalities, replacing it with direct guidance by the Ministry of Education and Science. The Russian authorities justified the measure on the grounds that too much attention had previously been placed on regional ethnic elements of education, to the detriment of Russian language, literature and history. Yet it is doubtful whether these centralisation measures can satisfy minorities' needs and aspirations given the strong ethnic identities created by earlier Soviet policies. Enabling true participation by minorities in decision-making on issues that concern them, including restoring the right of the regions to elect their own governors and shape their own education policies, is likely to be much more effective in harmonising ethnic relations in Russia than the Kremlin's current policy of enforced centralisation.

Federica Prina is a PhD student at the School of Slavonic and East European Studies

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Magnetricity

Despite the close link between the phenomena of electricity and magnetism, a key difference is that oppositely charged electrical particles can be separated from one another, whereas particles with a single magnetic charge are not usually found. Bob Aldus describes the recent fascinating discovery of magnetic monopoles in spin ice, and the exciting phenomenon of magnetricity that results from their movement.

Magnets have been of interest to human beings for at least 2000 years. Starting as mere oddities composed from magnetic material naturally embedded in rocks, they were used in compasses as long as 800 years ago and now find use in consumer electronics, electricity production and hybrid car engines.

Part of the reason that magnetism is useful is its relationship with electricity. Relative motion between a magnetic field and an electrical conductor results in an electric current as electric charges (electrons) are driven along the conductor. This is the principle behind the generation of electricity in power stations. The symmetries between magnetism and electricity are such that they are considered to be aspects of the same phenomenon: electromagnetism. However, there is one important difference, which is that single electric charges can exist in the form of particles like electrons (negatively charged) and protons (positively charged) which are constituents of all atoms. The opposite charges ensure that the negative electrons are attracted to the positive protons in the nucleus. If an electric field is applied, the electric charges can be accelerated; this is an electric current, or electricity. Although electricity and magnetism are intimately linked, there is no known magnetic equivalent of these positively or negatively charged electric particles.

A familiar example of a magnetic material is a bar magnet as shown in the figure. It has a north pole and a south pole, but if it is cut in half the magnetic poles are not separated; instead two smaller bar magnets are produced, each with its own north and south poles. In fact, no matter how many times a bar magnet is cut in half new magnets with north and south poles are always produced. If a single north or south magnetic pole could be isolated this would constitute a magnetic charge or monopole.

One way that this property of magnetic poles has been described is to say that whatever volume of the universe you look into, an equal number of north and south poles will always be found within it. This law is enshrined in Maxwell's equations which describe the relationships between electric and magnetic poles and fields. A similar law has been used to describe special magnetic materials with properties more complicated than those of a simple bar magnet.

In order to explain how we might be able to get magnetic properties in materials which are different from those in empty space, it is necessary to describe the materials in question. A material familiar to us all is common water ice. Ice forms when individual water molecules, each consisting of an oxygen ion connected to two hydrogen ions by short bonds are joined together by longer bonds to form an extended regular structure. The water molecule inside the tetrahedron (see figure)

A bar magnet (left) and the result of chopping it in half (right).

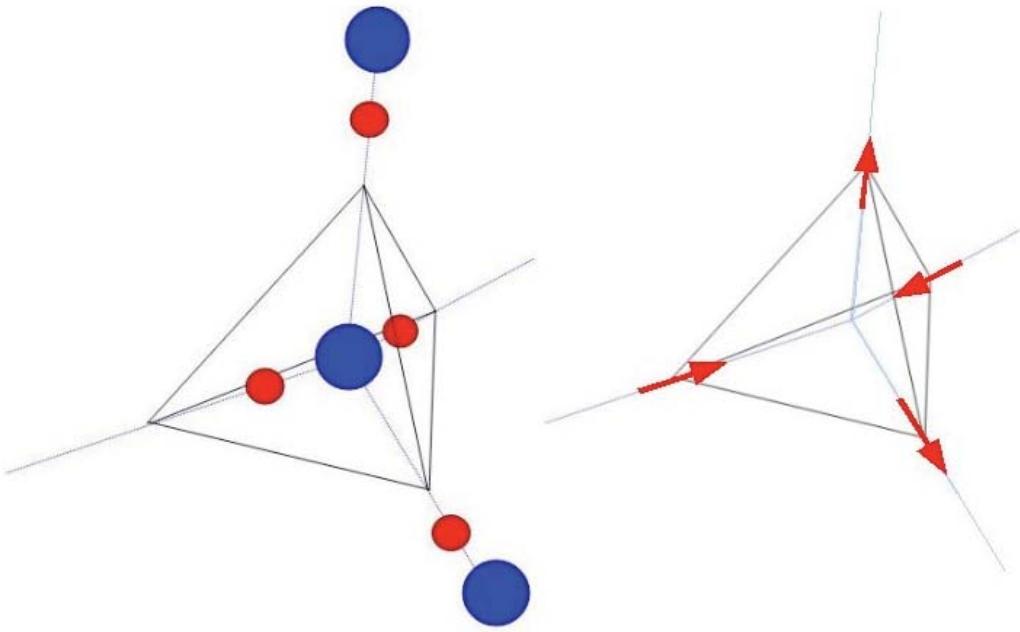
connects to other molecules outside the tetrahedron via long bonds. Ice has an unusual and unique property in that the positions of the hydrogen ions have some randomness about them. On each straight line that connects two oxygen ions there is one hydrogen ion which lies slightly closer to one of the two oxygen ions but cannot lie in the centre of the line. Each hydrogen ion is free to choose which oxygen ion it is closer to and which it is further away from, but two hydrogen ions are close to every oxygen and two are further away from every oxygen, so that the water molecules are bonded together – see the left hand part of the figure. This constraint is known as the *ice rules*.

There is a magnetic analogue of this situation which is found in a magnetic state known as *spin ice*. *Spin* is a term associated with magnetic moments. Spin ice obeys its own set of the ice rules: its magnetic ions are arranged on a tetrahedral lattice so that each tetrahedron has a magnetic *moment* (the strength and direction of the magnetic force) on each of its corners. The magnetic moments, represented as arrows, are free to choose which way to point so long as two always point into the tetrahedron's centre, and two always point away from it. This constraint is equivalent to the 'two close, two far away' rule in water ice.

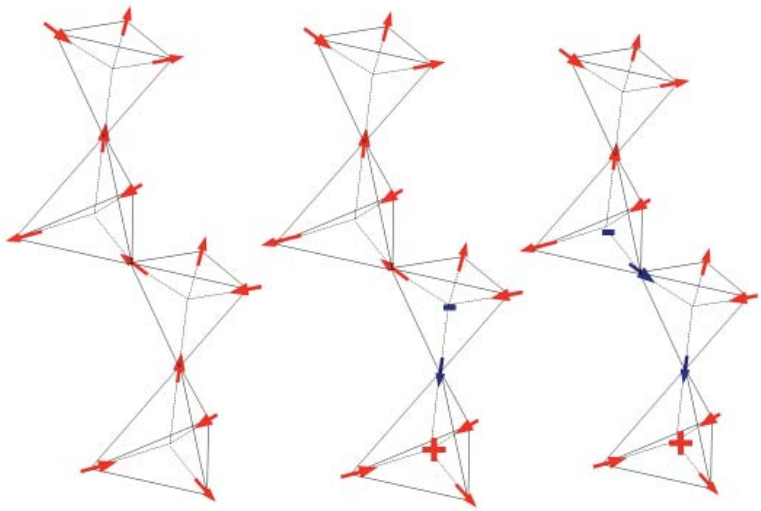
The rule that spin ice must have two magnetic moments pointing towards the centre of each tetrahedron and two pointing away is equivalent to saying that an equal amount of moments will point in as point out. This in turn is similar to the law mentioned earlier that whatever area of the universe you look into, there will always be an equal number of north and south poles. However, magnetic systems are always being disrupted by vibrations in the material, and may also be affected by an applied magnetic field. These disruptions can provide the energy the system needs to break the ice rules.

If one of the magnetic moments reverses or 'flips' its orientation then the ice rules are broken. This leaves one tetrahedron in a 3-in, 1-out state and one in a 1-in, 3-out state; one tetrahedron has more magnetic moments pointing in than out, and a neighbouring tetrahedron has more magnetic moments pointing out than in. This imbalance is, in fact, equivalent to the existence of separate magnetic poles, i.e. a positive magnetic charge in one tetrahedron and a negative magnetic charge in a neighbouring tetrahedron. As further flips occur these magnetic poles can move apart. Crucially this movement requires no further breaking of the ice rules, since only two tetrahedra are in a non-ice rules state at any one time. This movement of magnetic poles is exactly equivalent to the movement of electric poles such as electrons in an electric current. We therefore call this phenomenon 'magnetricity' to make clear that it is a magnetic equivalent of electricity.

So how do we know that this movement occurs? In order to reduce the vibrations which disrupt the spin



A water ice tetrahedron with hydrogen ions (red) and oxygen ions (blue) in an ice-rules configuration (left), and a spin ice tetrahedron in an ice-rules state with two magnetic moments pointing in and two pointing out (right).



The creation and movement of a magnetic monopole in spin ice. The ice rules state that each tetrahedron has two magnetic moments in and two out (left); the creation of a monopole via the flipping of the blue moment gives one 3 in, 1 out tetrahedron and one 1 in, 3 out tetrahedron (middle); and further magnetic moment flips allow the negative monopole to move away from the positive pole at no energy cost.

ice state we take crystals of spin ice which can contain around 1022 tetrahedra (that's 10 000 000 000 000 000 000 000 000 tetrahedra) and cool them down to below -273°C at a *neutron scattering* institute (the ones that we use are located in Oxfordshire and Grenoble, but other facilities can be found in Germany, the US and Australia). We fire neutrons at our crystals and measure the angles at which the neutrons scatter off the crystal. This technique gives us information on the magnetic structure of the material because the neutrons themselves are like tiny bar magnets which are scattered differently depending on which orientation the spin ice magnetic moments are in. We can then reconstruct what the magnetic moments in the system are doing from the pattern that is produced. Alternatively, we can implant *muons*, which are heavy electrons, into the material: muons decay into *positrons* (positively charged electrons) and the direction in which the positrons leave the spin ice depends on the orientation of the magnetic moments in the sample. So, by measuring the positron direction, we can construct the behaviour of the spins.

Spin ice was discovered in 1997 and people have been performing experiments on it ever since. Monopoles, however, weren't found until 2009, which demonstrates the subtlety of the effect and the difficulty in measuring it. The uses for magnetricity and magnetic charges in spin ice materials are not yet clear. In theory it may be possible to create devices and drive circuits as is done in current electronic systems, though the advantages of doing this are not yet known. One obstacle to the use of magnetricity is the extremely cold conditions required to produce it. The magnetic forces involved are of a low strength and are easily overcome by vibrations in the crystal, but these vibrations are reduced as the temperature is lowered. One possibility is to make artificial spin ice out of a magnetic material, ensuring that the tetrahedral structure is maintained. Since these artificial materials are larger they will be more robust to the vibrations which disrupt spin ice.

One final important difference between magnetricity and electricity is that, as the magnetic monopoles are not *actual* particles like electrons they can only exist inside the spin ice crystal: the monopoles can travel to the edge of the crystal but can get no further. This means you are in no danger of ever getting a 'magnetric shock'!

Bob Aldus is a postgraduate researcher in the Condensed Matter and Materials Physics group

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HIV: The Master-Sneak

"The most likely forecast about the future of infectious disease is that it will be very dull. There may be some wholly unexpected emergence of a new and dangerous infectious disease, but nothing of the sort that has marked the past fifty years."

Burnet & White, Natural History of Infectious Disease, 1972

The medical advances of the 20th century led to a great optimism in the fight against disease. At the beginning of the 21st, however, the battle is far from won. One of the most elusive victories is the development of a vaccine for HIV. How, asks Nicky Booth, has the virus escaped capture for so long?

Anyone who has lived through the very recent successive global scares of SARS and 'swine flu' will be aware that dangerous infectious diseases are, despite the hopes of some very eminent scientists, unfortunately not a thing of the past. New infections are still emerging, often spreading from their natural animal hosts to infect humans, a phenomenon known as zoonosis.

One of the most pernicious zoonoses to emerge since Burnet and White wrote their optimistic assessment is human immunodeficiency virus, or HIV. This is a virus which infects white blood cells, specifically CD4+ helper T cells and macrophages. Initial infection with HIV does not necessarily lead to noticeable symptoms, but as the infected cells are gradually destroyed – both by the virus itself and the patient's own immune system, which recognises the viral threat – the individual becomes unable to fight off other infections. At this point they are said to have Aids (Acquired Immunodeficiency Syndrome) and can be killed by another infection that would not threaten a healthy person.

Wasting diseases linked to opportunistic infections were initially detected in Africa in the 1970s, but the phenomenon was largely ignored in the developed world until similar symptoms were identified in some members of the gay community, and then among injecting drug users, in California and New York in 1981. The prevalence of this syndrome spread rapidly, being given its name (Aids) in 1982. Two years later, in 1984, the virus at the root of the syndrome was identified: HIV. Since then, the virus has been investigated in striking depth, but is still a problem: over 25 million people have died across the globe to date and in 2008 there were over 2 million new infections worldwide (UNAIDS AIDS Epidemic Update, 2009). Although there are antiviral drugs which can keep the virus under control, they do not cure the disease. They are also impractical for use to help patients in underdeveloped countries due to poor infrastructure and complicated drug regimens. It is clear that a vaccine is the best method of solving the global HIV epidemic. Why, then, with billions of pounds of public and private funding for research over 25 years, has no effective vaccine been found?

Vaccination is a method of preventing infections that relies on immunological memory. Antiviral vaccinations often use killed viruses (measles), small parts of the virus (Hepatitis B) or 'attenuated' viruses, which have been grown in the lab until they can no longer grow properly in a human (some polio vaccines), which usually injected into muscle tissue or taken orally and activate the immune system. They are eliminated easily, because they pose no real threat, but when the real virus is encountered it is recognised and destroyed rapidly before infection can take hold.

This principle doesn't work for HIV. For a start, it directly targets the immune system, weakening the infected person's principal weapon. It is also able to lie dormant within the infected cells for a very long period of

time, remaining undetectable throughout its dormancy. Additionally, it is a master of disguise due to its extraordinarily high rate of mutation.

In humans and other animals, genetic material needs to replicate itself in order for cells to divide for growth and repair, as well as procreation. This process of duplication is very carefully monitored to ensure the newly-generated genetic material is identical to its parent. Despite this, mutations do still occur; they can lead to defects and cancer, but are also a contributor to evolution.

In the case of HIV, the rate at which it replicates its genetic material is extraordinarily high – and so is its mutation rate. This means that the virus the immune system initially sees does not look the same as the virus it sees a few days later. It is like trying to memorise a picture that changes every time you look at it.

Some parts of HIV can't mutate so extensively. For example, the proteins that initially attach the virus to white blood cells and allow it to invade must stay the same so that they can bind the cells. However, even here the virus has mechanisms to evade recognition: these cell-binding proteins are hidden behind a wall of sugars that is able to change constantly. Only when they need to perform their function and bind to the cell do they emerge from behind their mutating curtain, and some patients have been able to take advantage of this brief window to generate antibodies against these proteins. But it is not enough.

The propensity of HIV to mutate and hide has been known for some time. However, more recently it has become clear that the virus may be using yet another strategy to evade the immune system. Traditional models of virus replication suggest that the viruses replicate within the cell, then either lyse (destroy) it or bud out through its external membrane. In either case, the newly-generated virions must then travel to find another cell to infect. This mechanism has two down-sides: firstly, it takes time to locate another cell to infect, limiting how rapidly the infection can spread; secondly, it makes the virions visible to the immune system, and hence vulnerable, while they are outside the cell.

Recent studies have indicated that HIV (as well as another, similar virus: Human T-Lymphotrophic Virus 1, HTLV-1) is able to use an alternative strategy, taking advantage of the ability of immune cells to form conjugates: in order to activate each other, white blood cells form a stable interaction and exchange stimulatory signals. The junction between them is termed the 'immunological synapse' and is highly stable: two cells can be attached in this way for several hours. It is also very precisely organised, with a specific structure centred around the T cell's main receptor molecule.

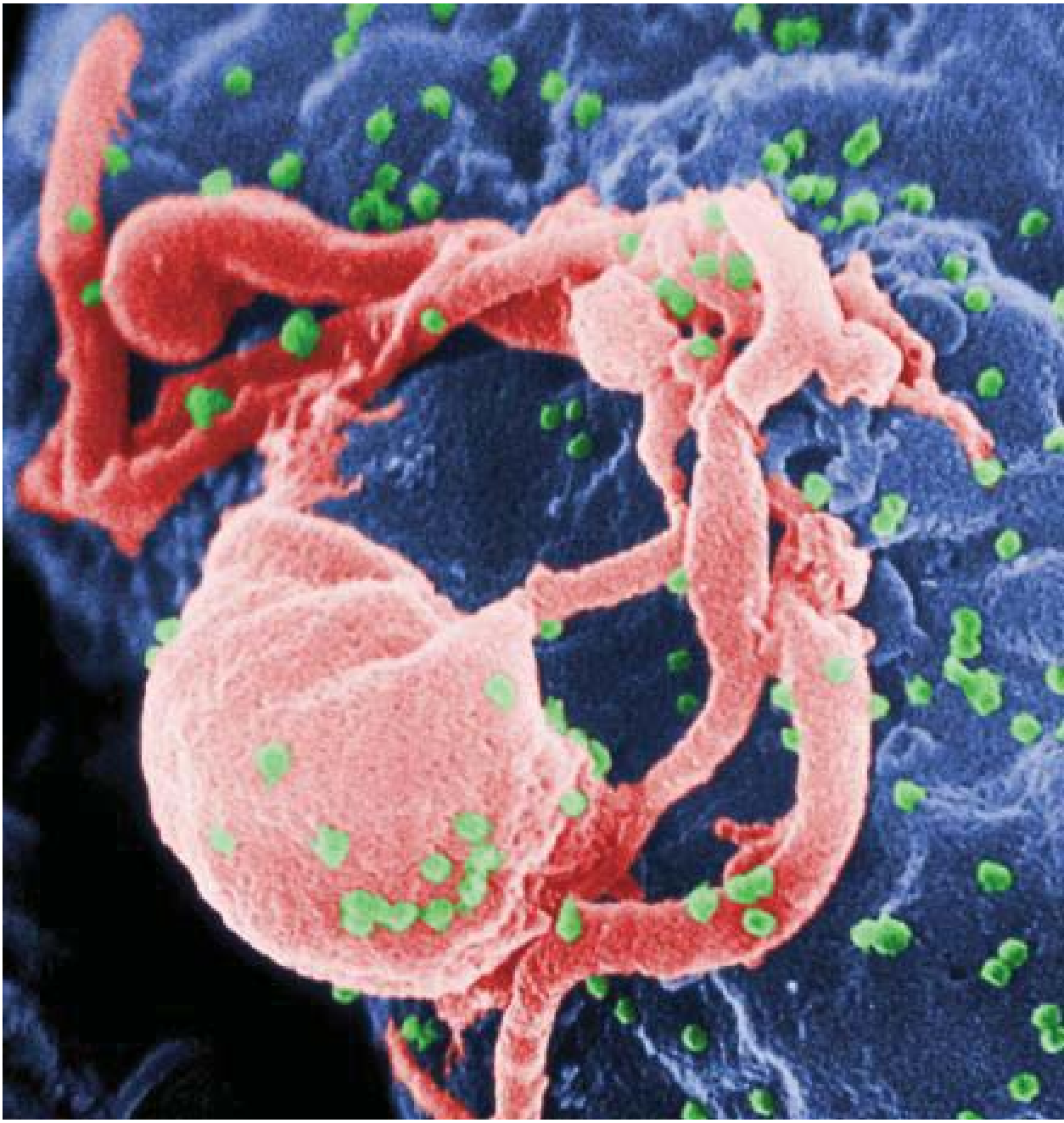
An HIV-infected T cell is able to form a similar junction with an uninfected T cell, which enables the virus to hop directly across the short gap between the two cells. It is thought that this route of infection is both more efficient than travelling long distances between T cells and may also help to protect it from antibody attack. Studies using infected cells in the laboratory have demonstrated that even without the rest of the immune system to contend with, HIV spread via these 'virological synapses' is significantly more rapid than viral diffusion between cells. It has been suggested that this method of virus spread might be especially effective in the lymph nodes, where large numbers of T cells accumulate in a small area.

Although evidence is accumulating that HIV-infected T cells can initiate one or many synapses with uninfected targets, and it has been shown that at least some of the proteins responsible for transport within the cell are involved, how exactly HIV manages to subvert its host cell in this way is not completely understood. Dr Clare Jolly, from the Division of Infection and Immunity, was one of the first to discover that HIV was able to form these synapses and to uncover some of the mechanisms involved. She is now working on uncovering which of the many intracellular transport routes the virus uses to get to the virological synapse, and how this process is controlled by viral proteins present at the surface of infected cells.

Although HIV is a difficult beast to trap, its extensive armoury is slowly being uncovered and understood and the discovery of cell-cell spread has shone a torch onto a new method of viral transfer. With any luck, it may one day join the ranks of those pathogens that have been rendered harmless by human ingenuity.

Nicky Booth recently completed a PhD in the Division of Infection and Immunity

Scanning electron micrograph of HIV-1 budding from cultured lymphocyte. Photo credit: C Goldsmith & Centers for Disease Control and Prevention.



Closer than We Think?

While the search for extraterrestrial intelligence scours the far reaches of space, extraterrestrial life could be much closer, and much simpler, than we thought. Sophie Atkinson and Charlie Harrison interview Lewis Dartnell about where we are likely to first find alien life, and what that means for humanity.

Mars. Photo credit: NASA.

Sophie Atkinson » Could you give us a brief overview of astrobiology?

Lewis Dartnell » In a nutshell, astrobiology is all about the search for life beyond the earth. But it encompasses a range of subjects: everything from microbiology and biochemistry to planetary science and astrophysics – trying to detect planets orbiting other stars in the galaxy and work out what kind of environmental conditions they might have. It's the overlap between lots of different disciplines of study and trying to answer questions about how life got started on earth, what conditions it needs and whether those conditions are satisfied on places beyond the earth and, therefore, where would be the best place to look for extraterrestrial life.

SA » So, where is the best place to look, do you think?

LD » At the moment a lot of people are focusing on our next-door neighbour planet: Mars. Partly because we think it was very much more Earth-like in the dawn of the solar system. So, 3 and a half or 4 billion years ago when life was getting started here, we know for a fact that Mars had liquid water flowing across the surface. It would have needed a thicker, warmer atmosphere and a greater greenhouse effect to keep the conditions for liquid water on the surface. It would have had organic molecules raining out of the sky aboard meteorites and comets in the same way that the early Earth did as well.

So Mars was very Earth-like at the dawn of life on Earth and would have provided the right conditions for life to have started there as well.

But also, Mars is relatively easy to explore: we can feasibly send robotic

probes to explore the surface or, in the near future, the sub-surface.

If you look beyond Mars, Europa is one of the icy moons of Jupiter and we've found signs that beneath the frozen shell there is a deep ocean of liquid water: a hidden alien ocean that we think contains more liquid water than all of the seas, rivers and lakes of Earth put together. So that might provide the right environment for life as well. The problem with that, obviously, is that it's buried beneath kilometres of solid ice. We'd have to land a probe that could drill or melt its way down to release a robotic submersible to look for signs of life. So, even if Europa might provide a better environment for life today, it's going to be very difficult to explore that environment.

Charlie Harrison » Are there plans for a project like that?

LD » We got a lot of information about Europa from the Galileo probe in the 1990s, but that mission has now finished. The follow-up mission is a joint mission between Nasa and the European Space Agency (Esa) where we would both send an orbiting probe to take lots of high-resolution photographs of Jupiter and its moons and then, towards the end of the mission, the probes would settle into orbit around Ganymede and Europa. The Europa orbiter would then give us proper cartography of the surface to work out how deep below the ice the ocean might be and where the best locations for further missions are; to find a crack that we could get a probe through to the ocean below. But it will be decades and decades before we get a probe actually into that ocean.

SA » So what stage are we at with probing the surface of Mars? Is that more advanced?

LD » It is, yes. Currently there are still two working probes on the surface of Mars. These are the Mars Exploration Rovers: Spirit and Opportunity, which are Nasa missions. Phoenix landed on Mars in May 2008, right up near the North Pole. Upcoming missions include the Mars Science Laboratory: a massive Jeep-sized rover that Nasa is going to be landing on the red planet in 2011. Later, a probe that I'm currently working on with other scientists here at UCL and in the UK and Europe is the Esa mission ExoMars, which is going to be launched in 2018. That's going to be very exciting because it will do things that we've never attempted on Mars before, such as trying to drill underground.

SA » So what's UCL's involvement with that mission?

LD » UCL's involvement is very direct in that the Mullard Space Science Laboratory is building a pair of robotic cameras – the eyes of the rover. ExoMars will be able to see in 3D as it drives around the surface to give us quite realistic imagery and also to help the probe to navigate around and provide the context of any measurements it takes with its other instruments. One idea with these PanCam cameras is to look for fluorescence from organic molecules by using a UV laser.

SA » So the UV laser is to look for signs of organic molecules like chlorophyll?

LD » Exactly. Or things like amino acids. Even simple, pre-biotic chemistry has never been detected on Mars, though we suspect it is there just from meteorites and comets. We have never detected any organic molecules on Mars, so trying to bag that detection itself would be a big deal.

SA » Isn't this all working on the assumption that any life on Mars would be made of the same biological building blocks that we have here on Earth?

LD » Yes. It's making the assumption that Martian life would be similar to terrestrial life in that it would be water based and carbon based. But that's not a massive leap of faith. It makes a lot of sense just in terms of the physics and the chemistry of it. Mars is a water world: it had water as a solvent on the surface and it had, as far as we know, organic chemistry and carbon-containing compounds – perhaps delivered aboard comets and meteorites. So it would have had the same basic building blocks of life as Earth. Perhaps they would have been put together in slightly different ways, but they would still be organic life rather than something more exotic.

SA » You hear sometimes about silicon-based life as well.

LD » Yes, in some ways silicon chemistry is quite similar to carbon chemistry, but you can't build polymers like DNA or proteins or the phospholipid bilayers that terrestrial life depends on out of silicon. Silicon chemistry is not as complex as carbon chemistry. So we'd certainly expect Martian life to be carbon based. But it might use subtly different molecules other than proteins or DNA.

SA » Is there the possibility that extra-terrestrial life might be related to terrestrial life?

LD » We'd expect to be similar in terms of its basic chemistry. And it's possible that it might be identical; that life on Earth and Mars might be the same via common descent.

Life might have evolved on either Earth or Mars and then have been transferred on a meteorite. We have got pieces of Mars on Earth that have been blasted off the surface of the planet and fallen as shooting stars, and laboratory experiments have demonstrated that cells inside rocks can survive the great pulse of the shockwave and heat generated when they're flung off as a meteorite so it seems feasible that life could be transferred between the inner planets of the solar system inside meteorites.

CH » Is it possible that you'd be able to get the same kind of transfer of organic matter between solar systems or even further?

LD » We think that life can be transferred between planets in the same solar system, but the physics and the maths don't work for transferring life between solar systems. You can't transfer cells inside rocks between different stars. The distance is just far too great and you'd have to be thrown off at such an incredible velocity to make that journey between stars – to escape the gravity of your own star system – that you'd have no chance of being captured and slowed down gently enough to survive when you arrive. So, if life on Earth was seeded from elsewhere, it would have been seeded by a very close neighbour: perhaps Mars or Venus, and not a star from elsewhere in the galaxy.

CH » Do you ever look beyond our solar system? Do you think it's likely that we might find life in other galaxies?

LD » We might find life within our own galaxy, or at least within the spiral arm of our galaxy, in the foreseeable future. We might even discover life on a planet around a distant star before we find any evidence of life in places like Mars or Europa. We've already discovered over 500 planets orbiting other stars in our galaxy in just the last 15 years and the follow-up experiments would be to build bigger space-based telescopes that can look at the light coming from these extra-solar planets and split that into an infra-red spectrum and then look for things like gaseous methane or oxygen. If you find both of those in the atmosphere of an alien planet that would be very strong evidence for biology (photosynthesis) on the surface of that world.

SA » Do you think that, if you find any signs of life on Mars that it would be still living or just evidence of life in the past?

LD » The surface of Mars has suffered an environmental catastrophe in that, over the billions of years of solar system history, Mars has had most of its atmosphere blown away into outer space and it's got very cold and dry on the surface. So no rivers flow any longer on Mars, although we see evidence of them in ancient times. Any life that was on the surface would have been driven to extinction, but biosignatures could be preserved in ancient ice in the top couple of metres of the ground or perhaps towards the North Pole or places where we see frozen lakes. If there was any life that was still active on Mars that isn't dormant, it would have to be pretty deep: kilometres deep in the crust, where the warmth of the planet is enough to start melting and thawing out the ice into, perhaps, deep aquifers of water. In similar environments on Earth, down to about 6 kilometres deep in the solid crust of the planet we find organisms thriving in the deep warmth of the planet. And actually we might have already discovered evidence of a deep biosphere on Mars.

We've seen curious plumes of methane gas seeping out of the ground, which might have been released by Martian methanogenic (methane-producing) bacteria in the same way that methanogenic bacteria on Earth release the gas as a product of their metabolism deep underground.

SA » So any life that was on Mars, or is still on Mars looks very different to the popular view of science fiction aliens!

LD » Yes, they're not going to be green bug-eyed monsters. There's going to be nothing more advanced than hardy, single-celled bacteria. It hasn't had the environment for long enough for evolution to progress beyond bacteria, and certainly not to things like animals because animals need an oxygen-rich atmosphere to support them and Mars has never had that.

SA » So would they be similar to the extremophiles that you find in the antarctic?

LD » Exactly. The kind of hardy organisms that we find on Earth, living inside solid icebergs, or in very acidic or alkaline waters are the kind of organisms that would be able to survive in the different environments on Mars. This is why we do a lot of microbiology work in extreme environments on Earth: to see what kind or survival strategies different organisms have developed and adapted there; and to see what kind of things might be able to survive on Mars.

CH » It sounds like you're quite confident of the prospect of finding bacterial life or, at least, single-celled life on other planets. What chance do you think that we might ever find macroscopic life, animal life or even intelligent life?

LD » If we're talking about the galaxy as a whole, there are almost certainly plenty of Earth-like planets out there. So there might be plenty of homes for life out there, but they might all be sterile because the exact conditions for life to have got started might not have occurred. I believe that there are plenty of wet rocks out there, smeared with microbial life. I believe that microbial life is common in our galaxy, but I think, for whatever reason, it hasn't progressed into complex intelligent animal life. I don't think there are any other intelligent species in our galaxy; at least not now. There might have been a long time ago but I don't think we share the galaxy with any intelligent species now.

SA » What drives this search for extraterrestrial life if all we are going to find is some bacteria?

LD » If we go back to astrobiology and the design of experiments and probes to search for life in our own solar system, rather than talking about Seti and the search for intelligence,

I think one of the main drivers is to think that, if we ever do find life, even if it is only primitive bacteria on Mars or in the alien ocean of Europa, it would be a discovery as monumental as realising that the Earth isn't flat; that we're not at the centre of the galaxy and that the Earth is just another planet orbiting the sun. It would be a 'Copernican revolution' to discover something that fundamental.

CH » What about the expense of these projects? Do you think that the technological developments we gain are enough on their own to justify the resources allocated to space programmes?

LD » Blue-skies science in general – any science that is not economically, environmentally or financially driven – is easy to attack. You can say 'it doesn't get me a better iPod, what's the point?', but it is the blue-skies science that leads to fundamental discoveries, which then open up whole suites of further research which have economic benefits. Astrobiology, which is one of these blue-skies fields of research, does have spin-off benefits that you wouldn't have predicted. One of these is from the Beagle probe that Britain built over a couple of years to look for evidence of life on Mars. Unfortunately the mission failed and we never got any results back from the probe. But, by trying to design instruments to look for organic molecules and signs of life on the Martian surface, they had to design very light instruments that ran on very low power for detecting chemicals. And that instrument has now been taken out of the probe and adapted to use in Africa to diagnose diseases like TB from breath or blood samples. So that is an immediate impact on society and everyday life from space technology.

SA » Do you think the UK has a strong position in space exploration?

LD » I think it does. It is true that Nasa spends more money on space exploration than any other nation. But I still think there is a really big role to play for the European Space Agency (Esa) as a whole and Britain's role within Esa. For example, on this ExoMars probe, Britain is one of the leading financial contributors and also one of the leading scientific contributors to the mission. So I think it's an important thing to be focused on, yes.

CH » Finally, what drove you to get involved in this field?

LD » Personal interest really. I think it's a really important question to answer. If we do find life beyond the Earth I think it would be an incredibly exciting and world-changing discovery. I'm not really doing it for the sake of society; I'm just doing it because I find it interesting myself. I find it hugely inspirational to be in the lab running experiments or computer models on Mars and trying to answer these questions - and it's a lot of fun!

Lewis Dartnell is a UCL Institute of Origins postdoctoral researcher, based at the Centre for Planetary Sciences